Missouri Department of Transportation

Bridge Division

Bridge Design Manual

Section 3.35

Revised 09/01/2004

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GENERAL

Strip Seal Expansion Joint System

Check the Design Layout for type of expansion device to be used. If no expansion device is specified, but due to the length of the structure an expansion device is required, consult the Structural Project Manager for type to use if uncertain.

Strip Seals should be used for movements greater than 2″ and less than 4″ in place of flat plate expansion devices for skews up to 45°. Use flat plates on curved structures and skews over 45°.

Use strip seal expansion joint systems within the limits described below:
Linear Expansion and Contraction

Coefficient of Linear expansion, α
Concrete structure: α = 0.000006 ft/ft/°F
Steel structure : α = 0.0000065 ft/ft/°F

Temperature Range:

	Rise	Fall	Range
Concrete structure:	50°F	70°F	120°F
Steel Structure:	60°F	80°F	140°F

Temperature Range is based on a design installation temperature of 60°F. The installation width, gap = 2″ at 60°F. The installation width (gap) should be adjusted for temperatures above or below the design installation temperture. Movement for a 10°F change in temperature should be indicated on the plans to the nearest 1/16″ by using note H5.63 in section 4.0.

The movement for 10°F change in temperature = α x 10°F x actual expansion length x the cosine of the skew angle.

Skew:

Strip seal expansion joint systems must be checked for parallel and perpendicular movements due to skew of the bridge.
Parallel movements (Racking) shall be less than 1-1/2″ for either rise or fall movements. Maximum skew shall be 45°.

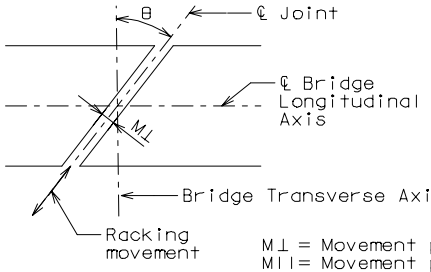
Design example for racking check:

Formula: $M = \Delta T \alpha L$: total movement or individual rise and fall movements
where
ΔT = corresponding temperature range
L = expansion length
α = coefficient of linear expansion

$M\perp = M \cos \Theta$: movement perpendicular to joint

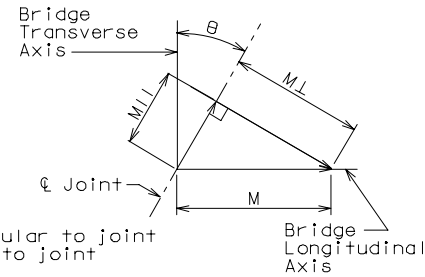
$M\parallel = M \sin \Theta$: movement parallel to joint
where
Θ = skew angle

GENERAL (CONT.)



M⊥ = Movement perpendicular to joint
M|| = Movement parallel to joint

Strip Seal Expansion Joint System



GIVEN:
Steel Girder Bridge, Expansion Length = 315′, Skew = 40°

FIND:
M, M⊥ , M|| and strip seal size (gap = 2″ at 60°F)

SOLUTION:

Step1: Calculate rise and fall movements along bridge CL of rdwy
Rise: Mr = 0.0000065 (60)(315′) = 0.1229′= 1.47″
Fall: Mf = 0.0000065 (80)(315′) = 0.1638′= 1.97″

Step2: Calculate the movement perpendicular to joint
Rise: M⊥(r) = Mr cos40°= 1.47″x cos40°= 1.13″
Min. Gap = 2″- 1.13″= 0.87″> 0″ OK
Fall: M⊥(f) = Mf cos40°= 1.97″x cos40°= 1.51″
Max. Gap = 2″+ 1.51″= 3.51″, use 4″ Gland
(See Gland Size Selection Table)

Step3: Calculate the movement parallel to joint
(Check Racking Movement)
Rise: M||(r) = 1.47″x sin 40° = 0.94″< 1.5″ OK
Fall: M||(f) = 1.97″x sin 40° = 1.27″< 1.5″ OK
∴ Racking is OK for 40° Skew.

GLAND SIZE SELECTION TABLE

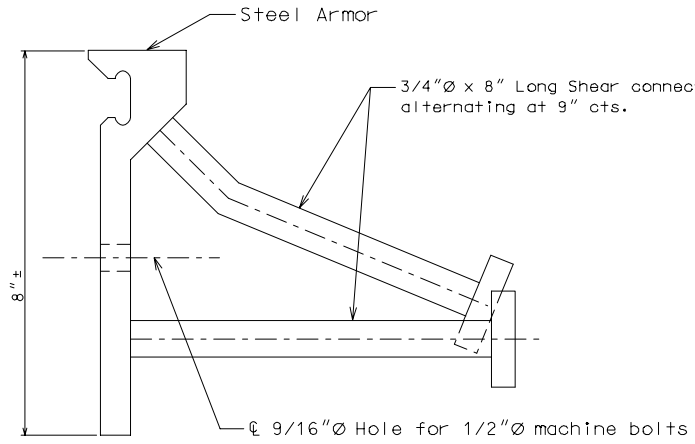
STRIP SEAL GLAND SIZE	GAP AT TOP SLAB (60°F)	MIN. JOINT WIDTH	MAX. JOINT WIDTH
3″	2″	0″	3″
4″	2″	0″	4″

MAXIMUM EXPANSION LENGTHS WITH GAP AT TOP SLAB = 2″ AT 60°F

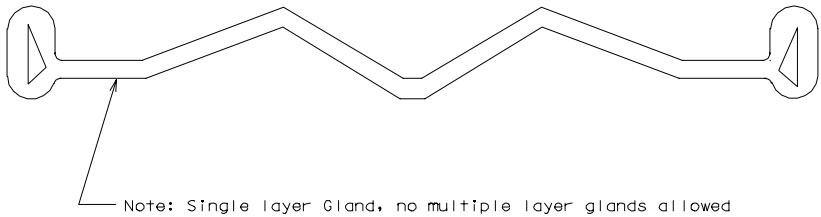
	Max. Expansion Length (Skew = 0°)(✳)	
	3″ Gland	4″ Gland
CONCRETE BRIDGE	198′	396′
STEEL BRIDGE	160′	320′

(✳) For skewed bridge, follow the above example with consideration of racking movement.

Note: Do not use Strip Seal Expansion Joint Systems for skews greater than 45° or for curved bridges, Use Flat Plate Expansion Devices.



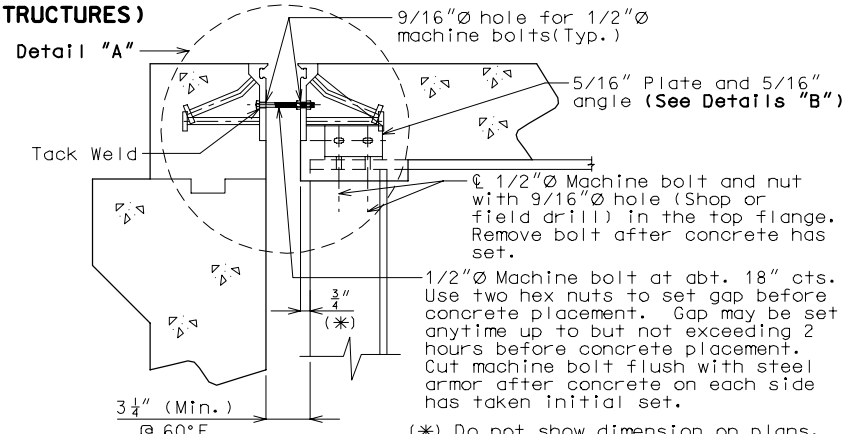
DETAIL OF JOIN ARMOR



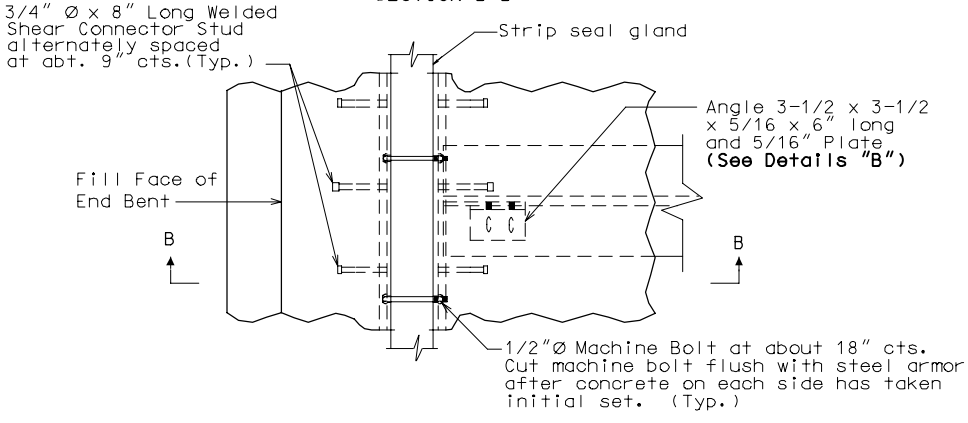
DETAIL OF GLAND

DEVICE DETAILS AT END BENTS (STEEL STRUCTURES)

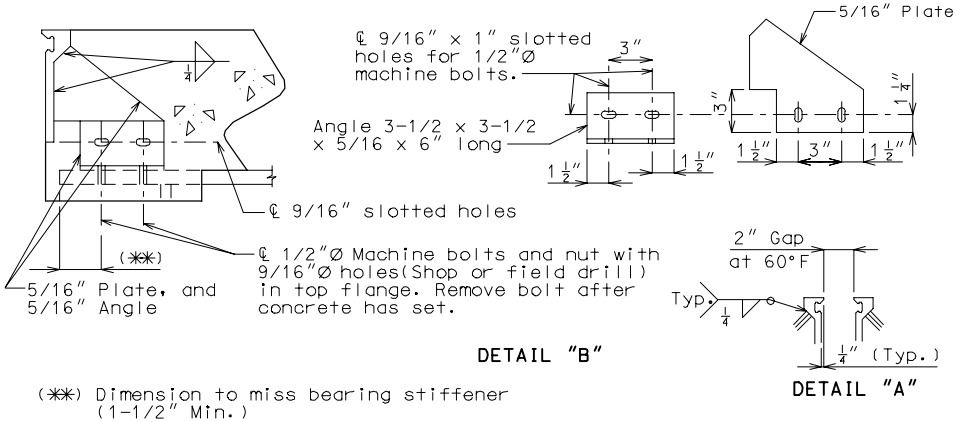
Strip Seal Expansion Joint System



SECTION B-B



PART PLAN

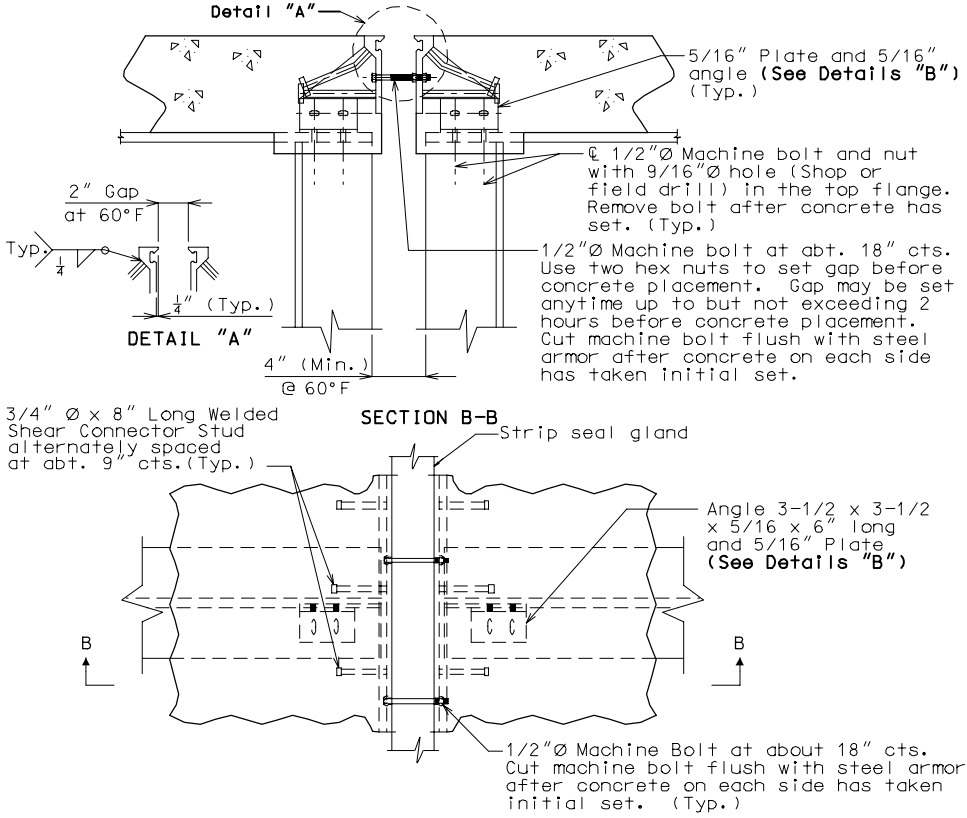


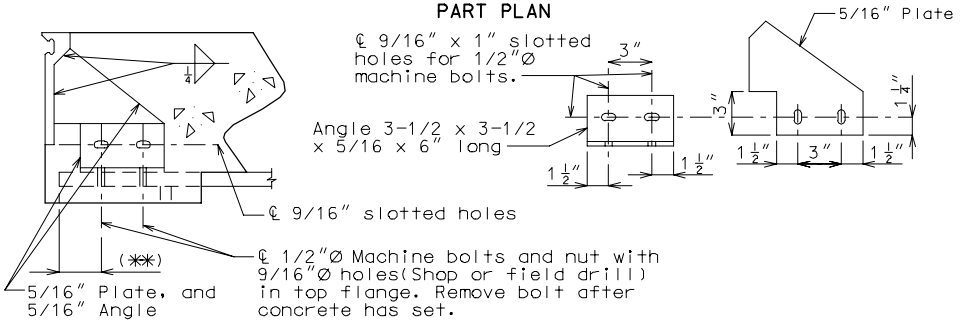
DETAIL "B"

DETAIL "A"

(**) Dimension to miss bearing stiffener (1-1/2" Min.)

DEVICE DETAILS AT INTERMEDIATE BENTS (STEEL STRUCTURES) Strip Seal Expansion Joint System





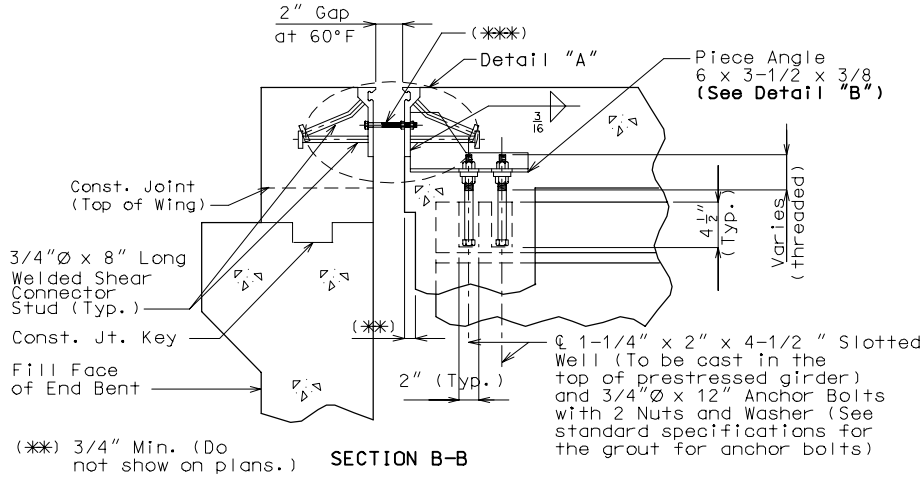
DETAIL "B"

(**) Dimension to miss bearing stiffener (1-1/2" Min.)

DEVICE DETAILS AT END BENTS (PRESTRESSED STRUCTURES)

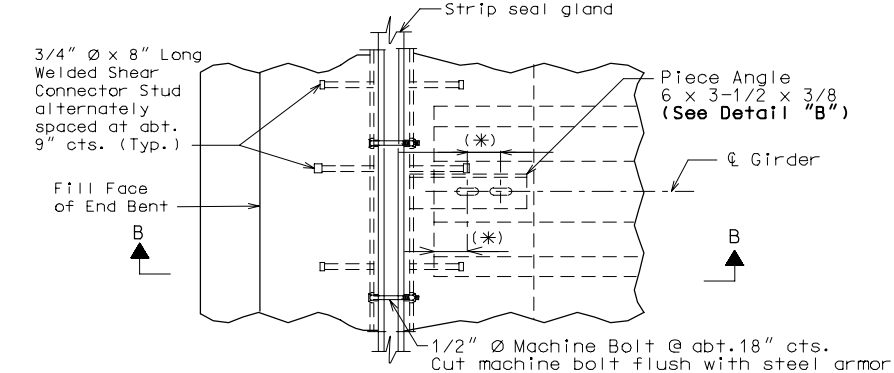
Strip Seal Expansion Joint System

(***) 1/2" Ø Machine Bolt @ abt.18" cts. Use two hex nuts to set gap before concrete placement. Gap may be set anytime up to but not exceeding 2 hours befor concrete placement. Cut machine bolt flush with steel armor after concrete on each side has taken initial set.



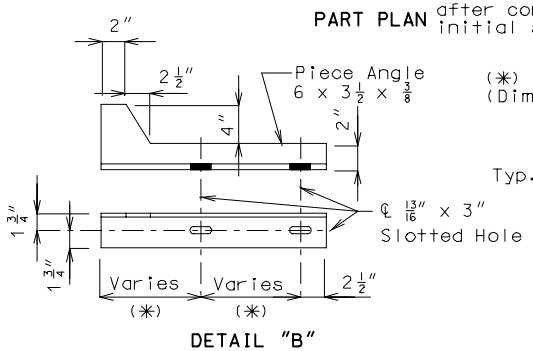
(**) 3/4" Min. (Do not show on plans.)

SECTION B-B

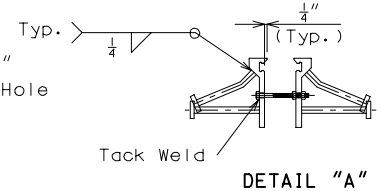


PART PLAN

(*) Dimension along ℄ of girder. (Dimensions to be shown on plans.)



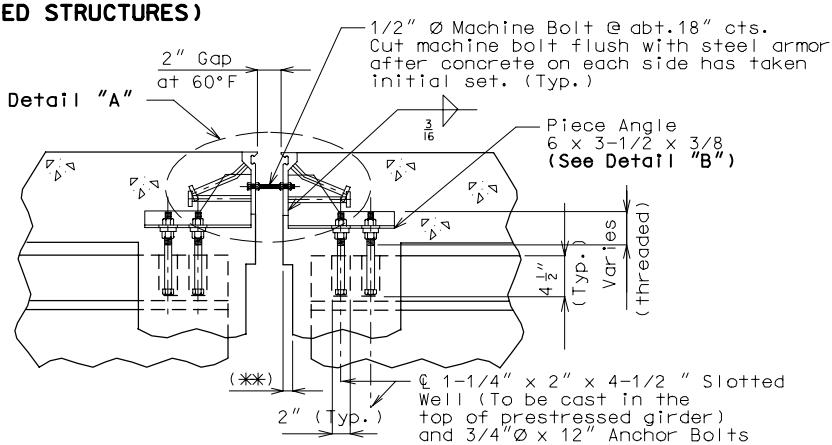
DETAIL "B"



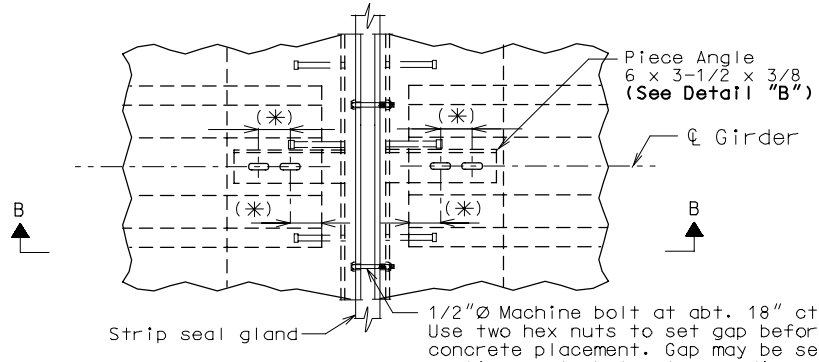
DETAIL "A"

DEVICE DETAILS AT INTERMEDIATE BENTS (PRESTRESSED STRUCTURES)

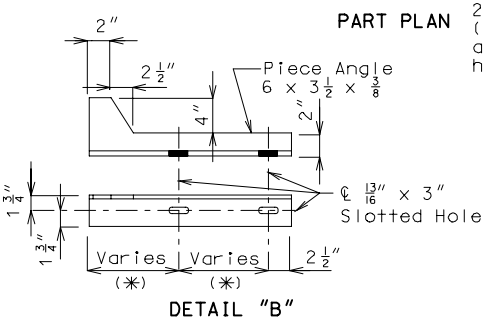
Strip Seal Expansion Joint System



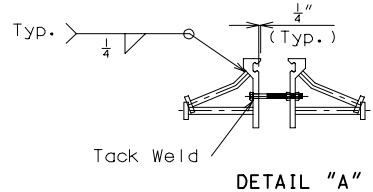
SECTION B-B



PART PLAN



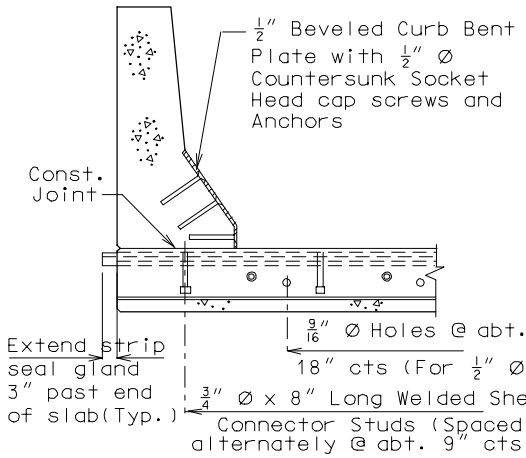
DETAIL "B"



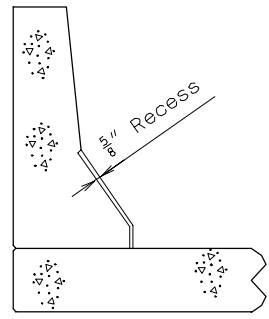
DETAIL "A"

(*) Dimension along ℄ of Girder (Dimension to be shown on plans).

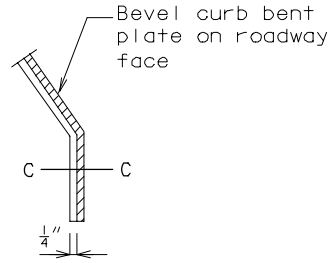
BARRIER CURB DETAILS **Strip Seal Expansion Joint System**



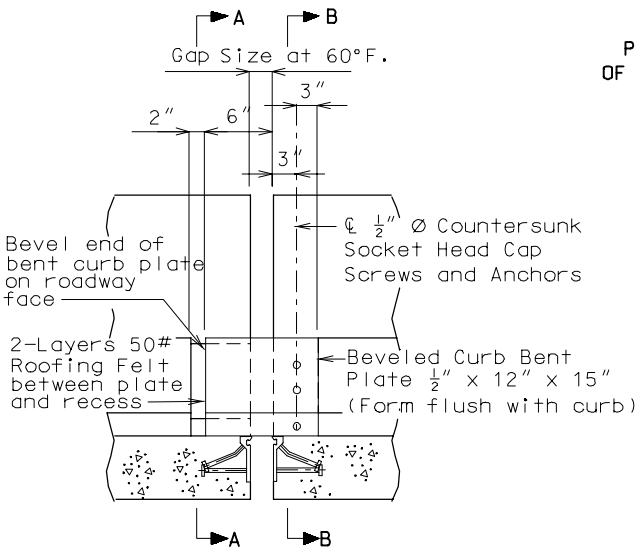
PART SECTION B-B



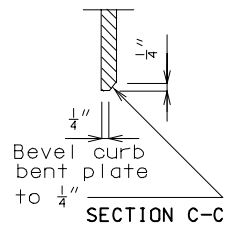
PART SECTION A-A



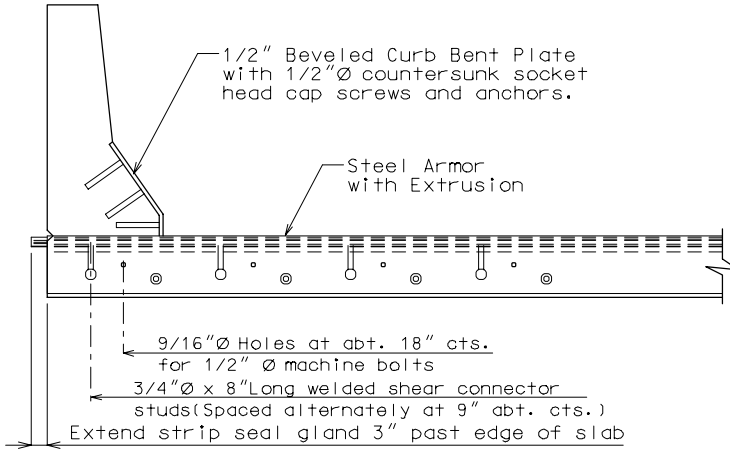
PART ELEVATION AT END OF BEVELED CURB BENT PLATE



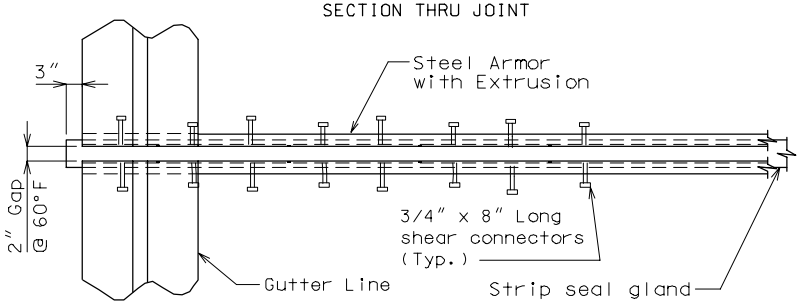
PART ELEVATION OF BARRIER CURB



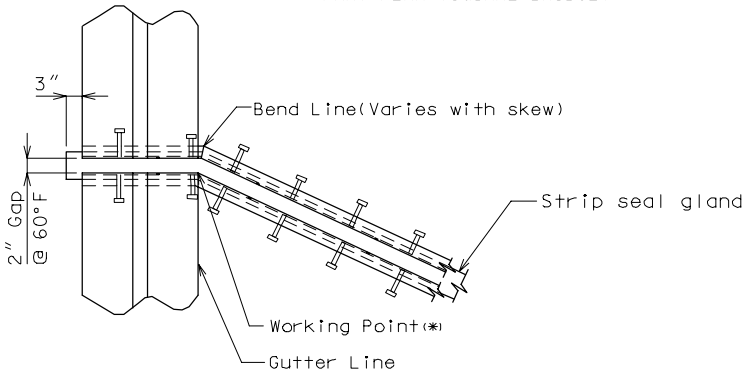
SECTION C-C



SECTION THRU JOINT



PART PLAN (SQUARE BRIDGE)

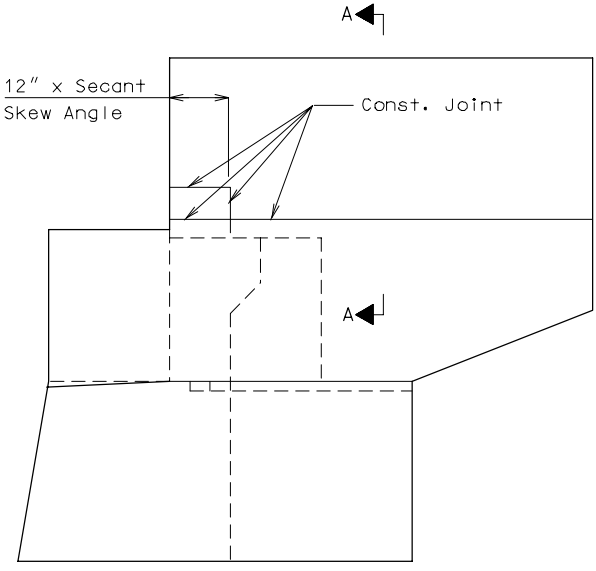


(*) Working Point is always at Front Face of Backwall at gutterline.

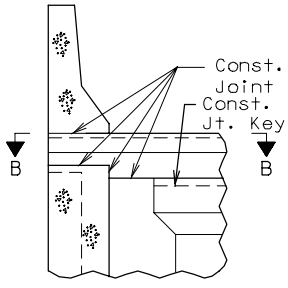
PART PLAN (SKEWED BRIDGE)

DOUBLE FACED MEDIAN BARRIER BRIDGE CURB

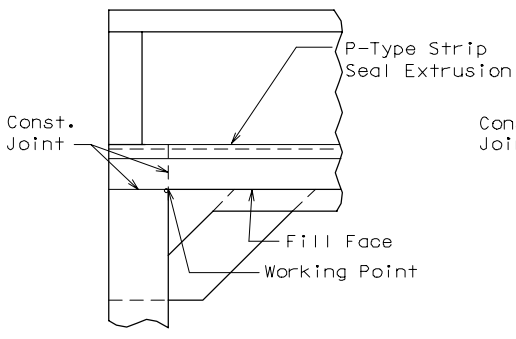
Strip Seal Expansion Joint System



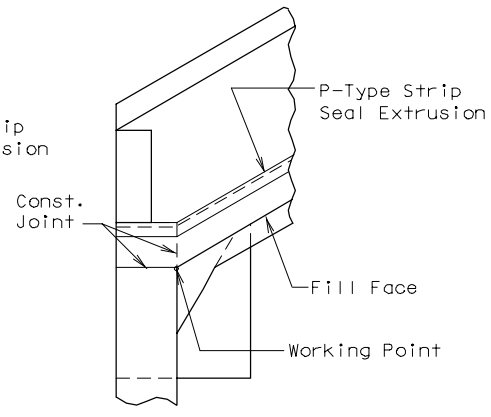
ELEVATION



PART SECTION A-A



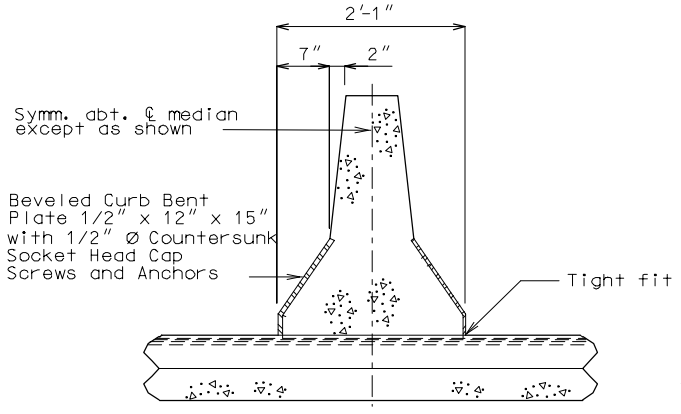
PART PLAN B-B
(SQUARE)



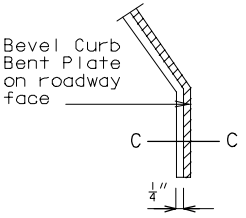
PART PLAN B-B
(SKEWED)

Note:

For details not shown of median barrier bridge curb, see the safety barrier curb details (General Superstructure Section of Bridge Manual), Design Division Standard Drawings (Concrete Median Barrier) and Bridge Design Layout.

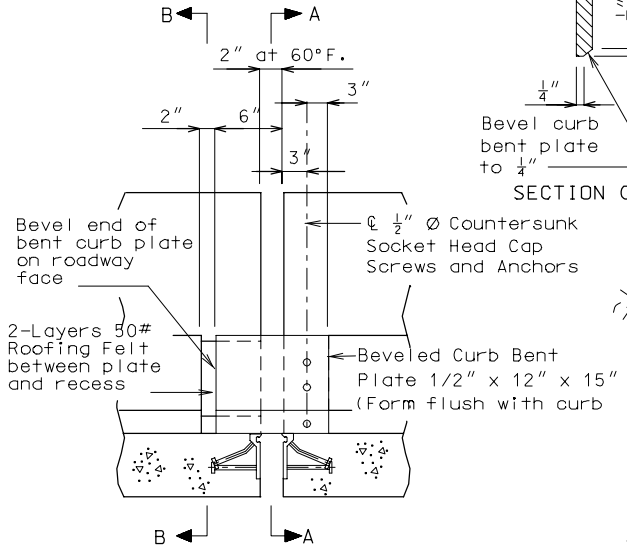


TYPICAL PART SECTION A-A



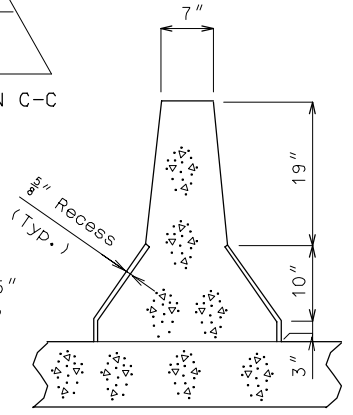
PART ELEVATION AT END OF BEVELED CURB BENT PLATE

Note: Use continuous strip seal thru median curb only when slab cross-slope slopes away from curb or slab is superelevated.



PART ELEVATION OF BARRIER CURB

SECTION C-C

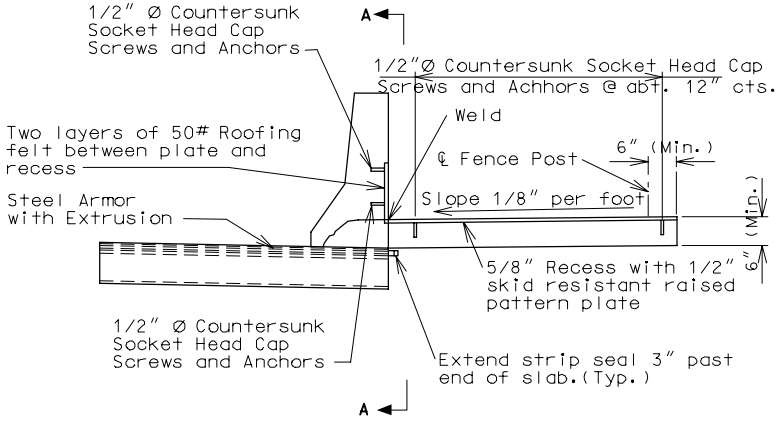


TYPICAL PART SECTION B-B

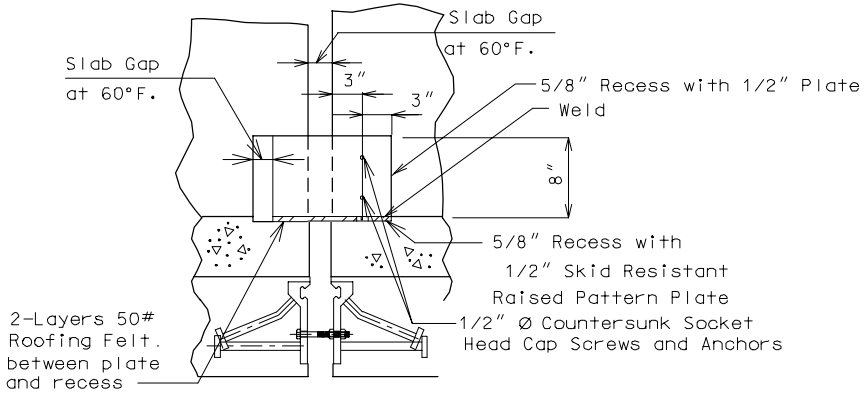
SIDEWALK DETAILS

Strip Seal Expansion Joint System

Note: See Bridge Manual Section 3.30 (General Superstructure) for details and reinforcement of the sidewalk and Bridge Manual Section 4.0 (General Notes) for the appropriate notes to use on the bridge plans.



PART SECTION THRU CENTER OF EXPANSION DEVICE



PART SECTION A-A

In order for strip seal expansion joint systems to function properly the gland must be allowed to drain to prevent build-up of debris. Debris may punch holes in the gland and the weight may possibly pull the gland from the extrusions.

To prevent debris buildup on the strip seals the gland should not be turned up at the barrier curb. Instead the steel armor with extrusions should run to the face of the slab through the barrier curb.

Drainage should be handled by one of two methods. The first method is to let the water run off the gland and free fall to the ground below.
The gland should extend past the face of the barrier curb by a minimum of 3 inches. At intermediate bents, the bent cap should have a protective coating applied to prevent moisture saturation of the concrete. On structures where there is an adjacent structure separated by a median barrier curb with an open joint(Type D or Split median) the gland should be terminated at some point in the curb at all bent types and protective coating should be applied at all faces exposed to moisture.

The second method of drainage is to provide a fiberglass pipe drainage system to collect water at the bents.

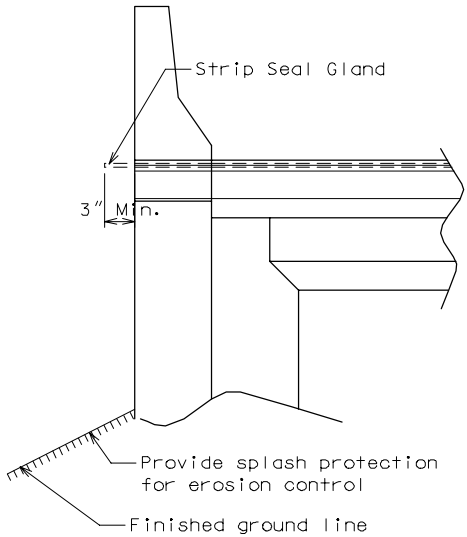
See the Structural Project Manager for the method of drainage to be used.

The following pages provide some possible details that may be used for strip seal expansion joint drainage systems.

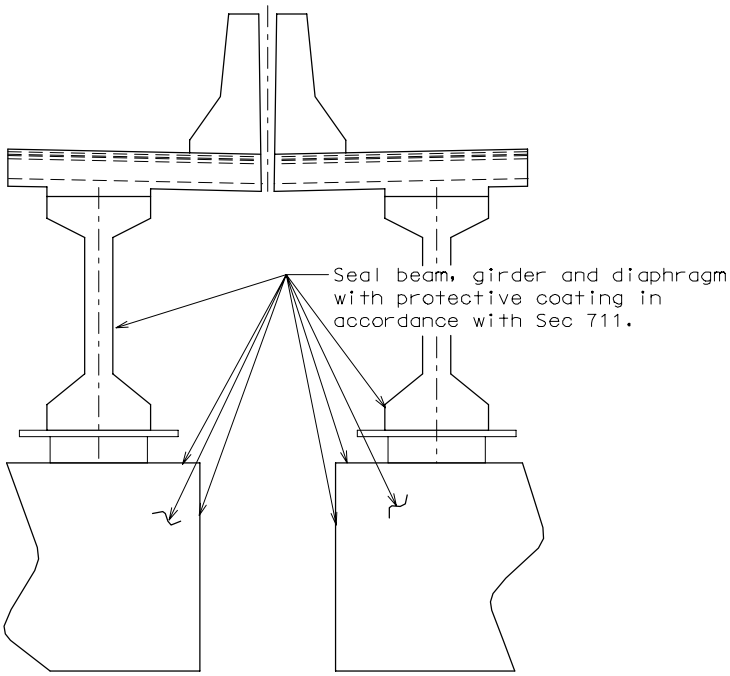
If the fiberglass pipe drainage systems is used, payment will be made under the pay item, Drainage System(On structure), Lump Sum.

Option #1

(Typical for all bents except for split median barrier curb.)

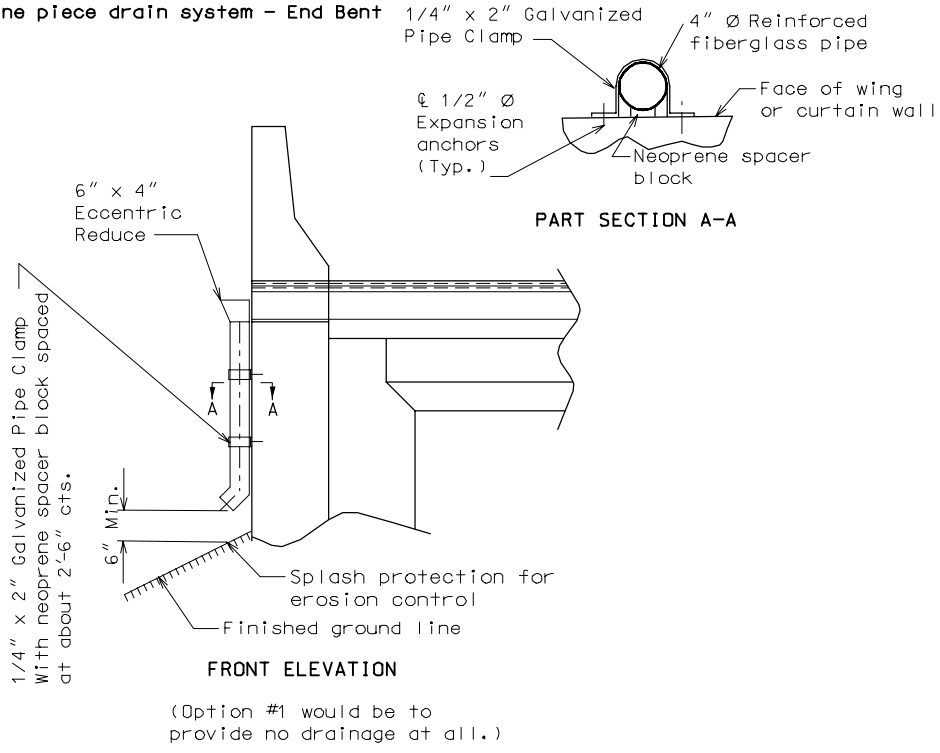


Option #1
No Drainage System - Intermediate Bent

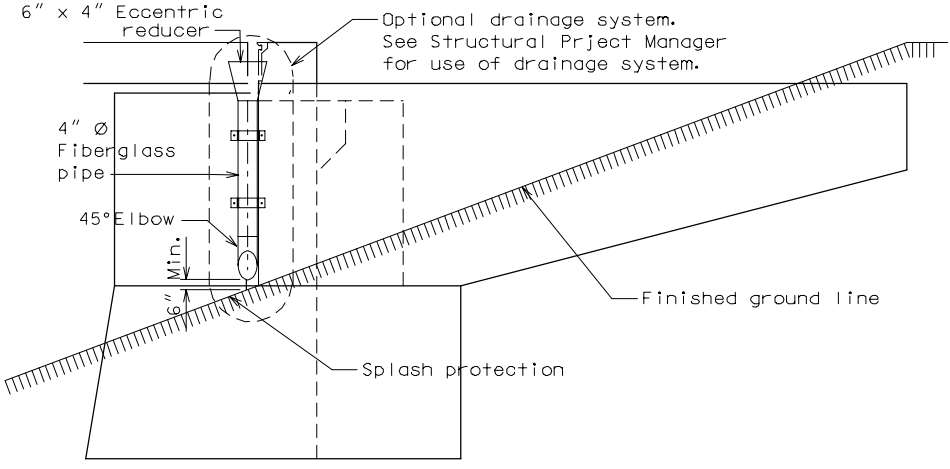


Option #2

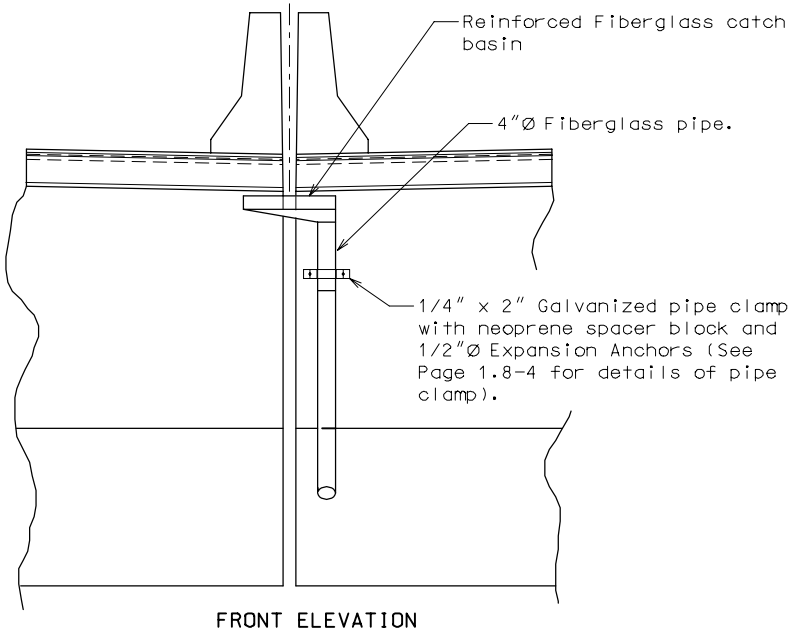
One piece drain system - End Bent



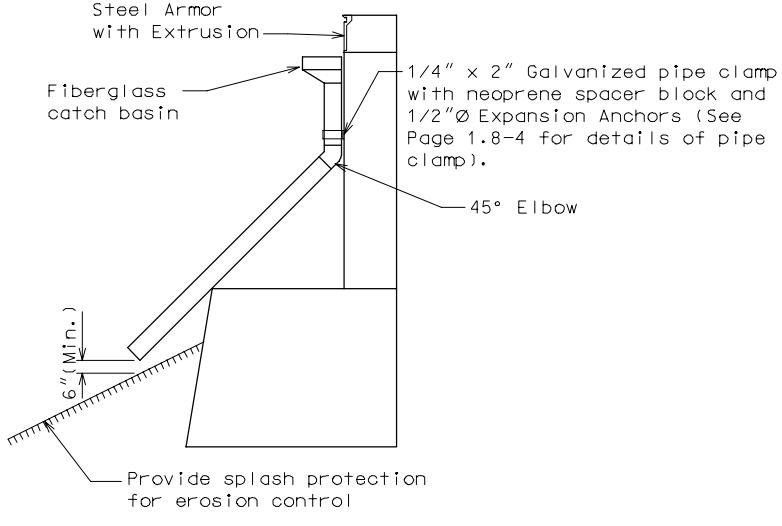
(Option #1 would be to provide no drainage at all.)



Option #2
One piece drain system - End Bent
(Option #1 would be to provide no drainage at all.)

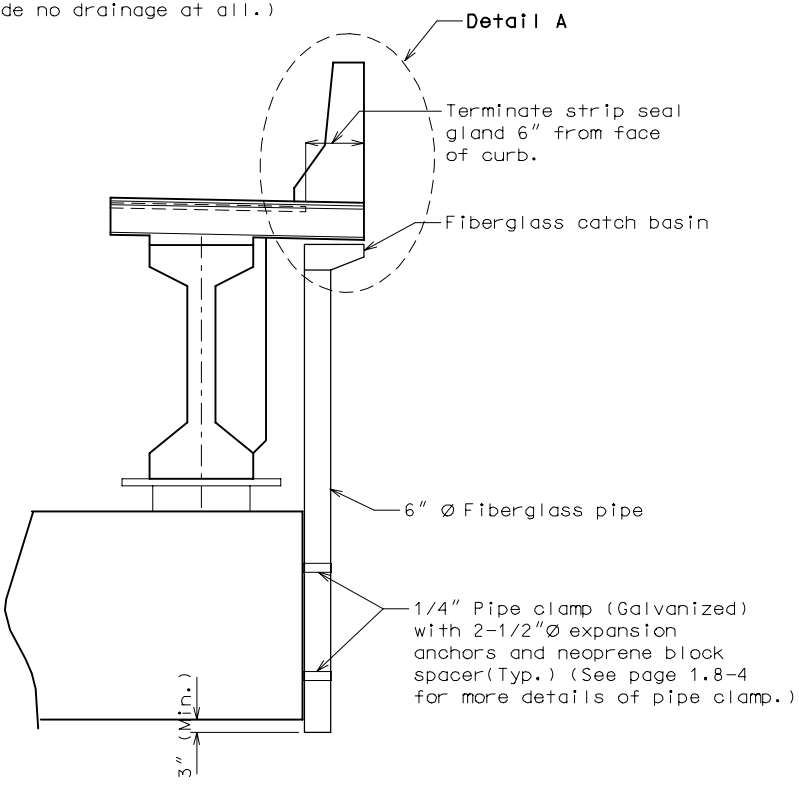


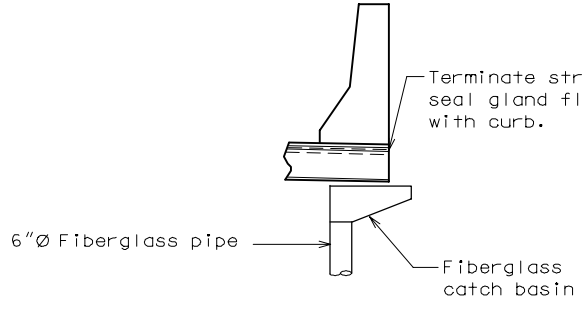
FRONT ELEVATION



SECTION THRU BENT

Option #2
One piece drain system - Intermediate Bent
(Option #1 would be to provide no drainage at all.)



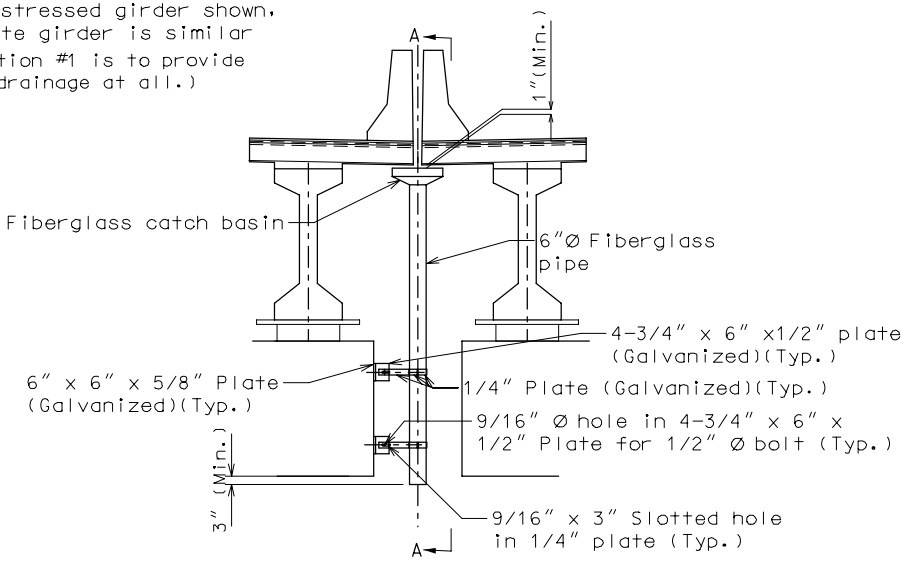


Detail A
(Optional)

Option #2

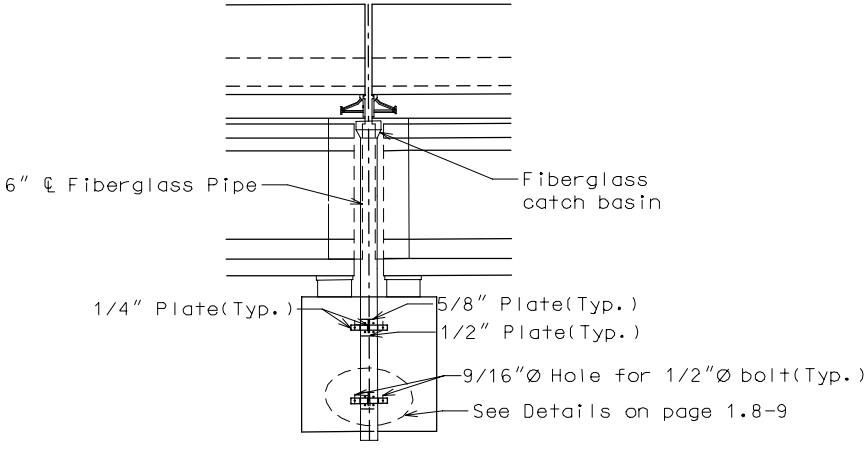
One piece drainage system provided - Intermediate Bent

Prestressed girder shown, plate girder is similar (Option #1 is to provide no drainage at all.)



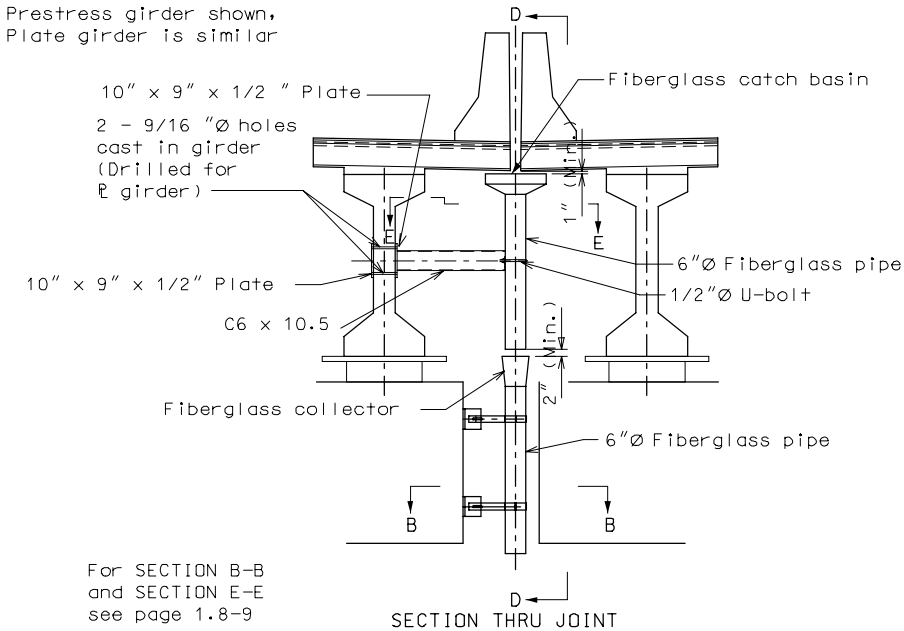
SECTION THRU JOINT

Note: If dropping water to ground from bottom of beam is not allowed, an additional pipe system shall be used.



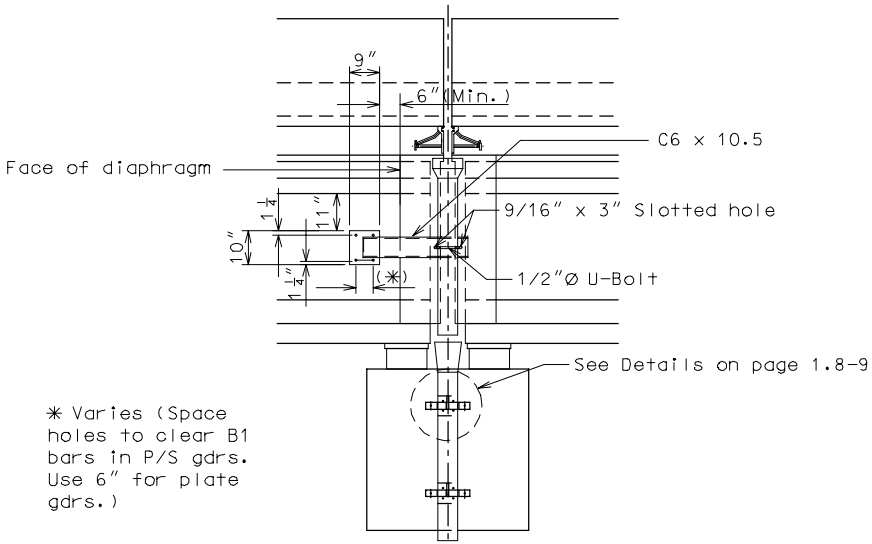
SECTION A-A

Option #3
Three piece drainage System provided - Intermediate Bent.



For SECTION B-B
and SECTION E-E
see page 1.8-9

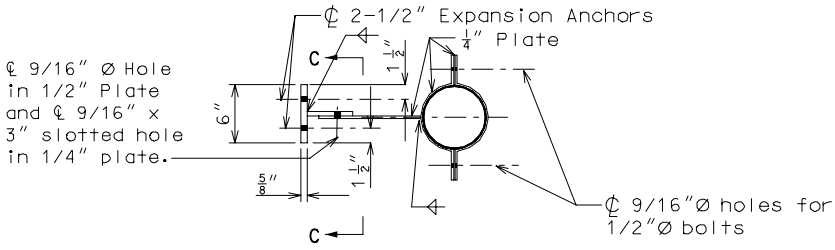
SECTION THRU JOINT



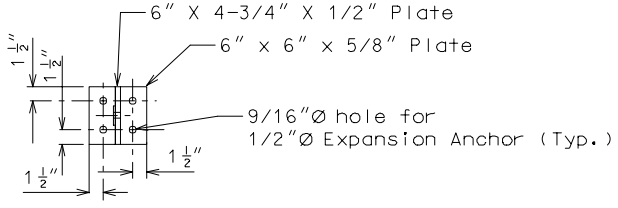
* Varies (Space holes to clear B1 bars in P/S gdrs. Use 6" for plate gdrs.)

SECTION D - D

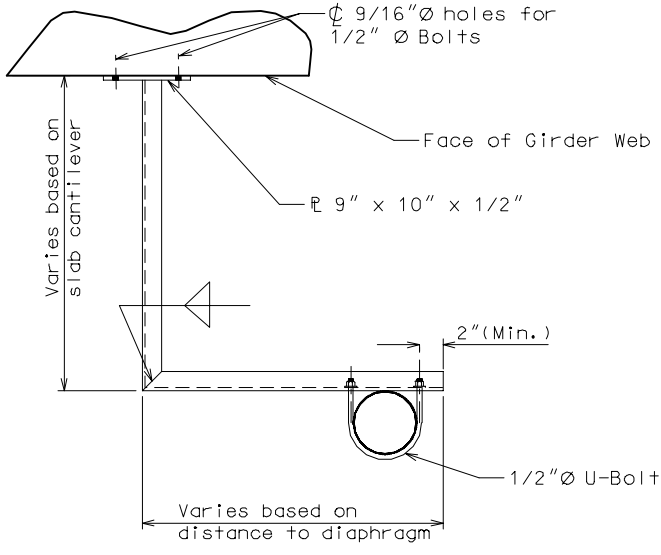
Option #2 or #3
Drainage System provided - Intermediate Bents



SECTION B-B



SECTION C-C

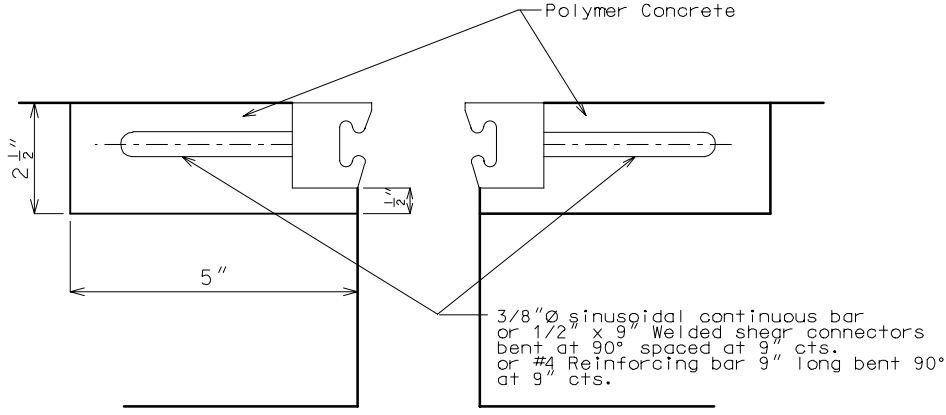


SECTION E-E

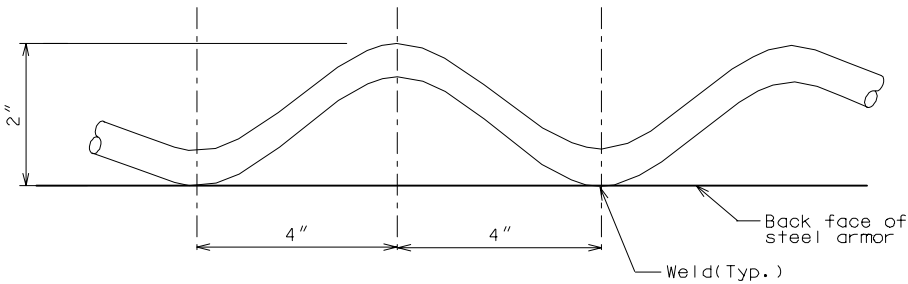
POLYMER CONCRETE

Strip Seal Expansion Joint System

Strip Seal Expansion Joints may be used on rehabilitation projects where other expansion devices need to be replaced. Consult with Structural Project Manager about the use of polymer concrete with strip seals. Strip seal is to be designed with the same requirements as a normal strip seal expansion joint.

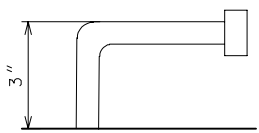


Note: Anchorage system shall be welded to strip seal steel armor with appropriate weld to meet AASHTO Fatigue Category C for connection.



DETAIL OF SINUSOIDAL BAR

Note: A pay item exists for this type of expansion joint system. The system will be paid for under Strip Seal Expansion Joint System per linear foot. Polymer Concrete will be paid for under Polymer Concrete per cubic foot.



DETAIL OF SHEAR CONNECTOR

(#4 Reinforcing bar shall be bent in a similar manner)

GENERAL

Check the Design Layout for type of expansion device to be used. If no expansion device is specified, but due to the length of the structure an expansion device is indicated, consult the Structural Project Manager for type to be used.

LINEAR EXPANSION AND CONTRACTION:

Coefficient of Linear Expansion, α

Concrete Structure: $\alpha = 0.000006$ ft/ft/°F

Steel Structure: $\alpha = 0.0000065$ ft/ft/°F

TEMPERATURE RANGE FROM 60°F	Rise	Fall	Range
Concrete Structure:	50°F	70°F	120°F
Steel Structure:	60°F	80°F	140°F

Movement for a 10°F change in temperature should be indicated on the plans to the nearest 1/16″ by using note (H5.32) in Section 4.

The movement for a 10°F change in temperature = α x 10°F x Actual Expansion Length x Cosine of the Skew Angle.

GENERAL (CONT.)

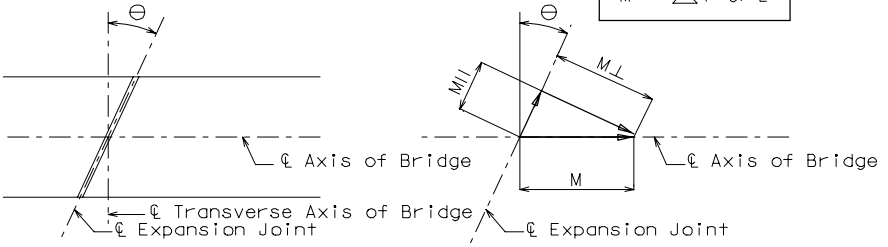
Typical calculations for skew solution.

FORMULAE

$M\perp = M \cos\Theta$

$M\parallel = M \sin\Theta$

$M = \triangle T \propto L$



GIVEN: Total bridge movement along the centerline of bridge has been calculated at 1.08".

$\therefore$ M = 1.08"

FIND: The proper seal at the skew angle $\Theta = 30°$ and with the joint opening at 60°F.

Θ = Skew Angle of Expansion Joint.

M = Total Movement of Bridge.

$M\perp$ = Total Movement Perpendicular to Joint.

$M\parallel$ = Total Movement Parallel to Joint

Wn = Nominal Width of sealer.

St = Total Allowable Rack Due to Exp. and Contr.

SOLUTION:

Step 1: Calculate the total movement $\perp$ to the joint.

$M\perp = M \cos\Theta$
$= 1.08" \times 0.866$
$= 0.935"$ Required Seal Movement Range

Step 2: Calculate the total movement $\parallel$ to the joint.

$M\parallel = M \sin\Theta$
$= 1.08" \times 0.5$
$= 0.54"$

Step 3: Select proper seal size to accommodate the above rack (movement $\parallel$ to the joint).

$St = M\parallel = (0.20\ Wn)(*) = 0.54"$
$Wn = 0.54"/0.20 = 2.7"$

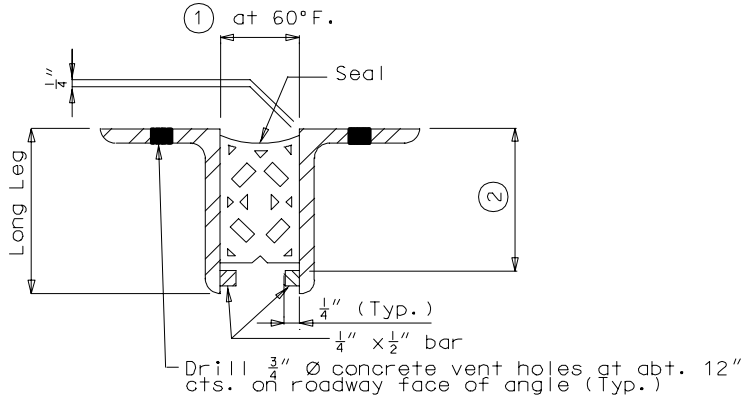
Step 4: Select proper seal size to accommodate the movement $\perp$ to the joint).
Knowing the minimum size seal should be 2.7" or greater and the movement rating approximately 1" (0.935") we can go to the selection chart (**). The smallest seal that meets necessary parameters is the 3".

* Most engineers permit a maximum allowance of 15% to 20% of the nominal seal width (Wn) for rack caused by skew movements. (USE 20% IN ALL CASES).

** See Sec. 3.35 page 2.2-1.

Preformed Compression Joint Seal

TABLE OF TRANSVERSE BRIDGE SEAL DIMENSIONS

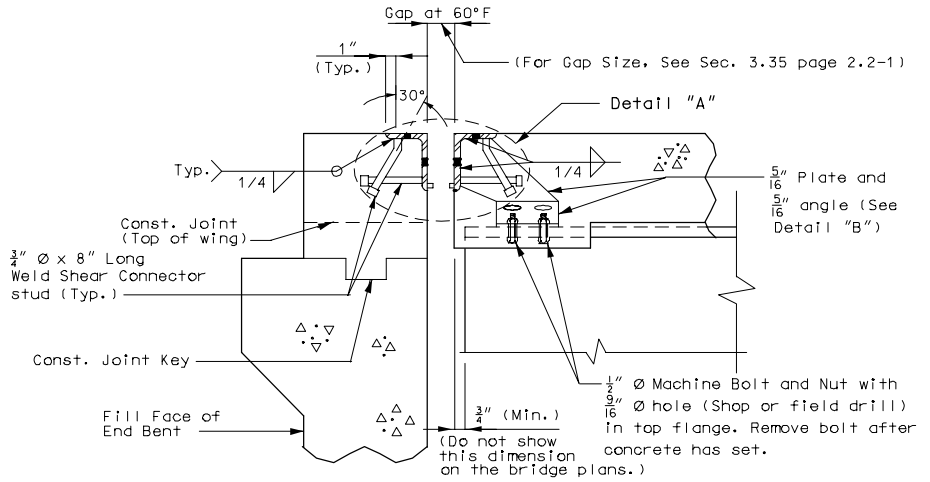


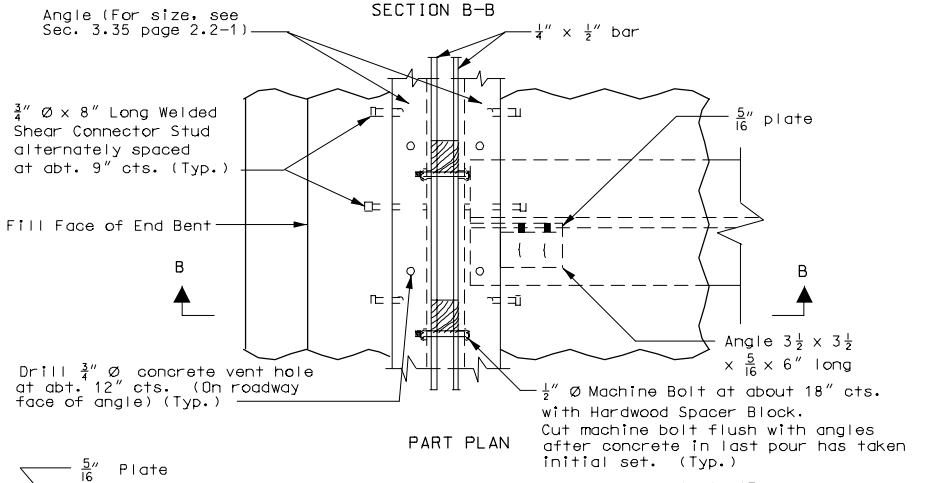
PART CROSS SECTION THRU EXPANSION JOINT

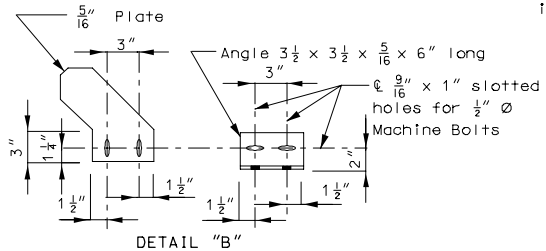
TABLE OF TRANSVERSE BRIDGE SEAL DIMENSIONS			
SEAL WIDTH (Wn)	①	②	REQUIRED MOVEMENT RANGE(M⊥)
2.5"	1 5/8"	MANUFACTURER'S RECOMMENDED HEIGHT	0.9"
3.0"	1 7/8"	MANUFACTURER'S RECOMMENDED HEIGHT	1.0"
3.5"	2 1/4"	MANUFACTURER'S RECOMMENDED HEIGHT	1.3"
4.0"	2 5/8"	MANUFACTURER'S RECOMMENDED HEIGHT	1.6"
4.5"	2 3/4"	MANUFACTURER'S RECOMMENDED HEIGHT	1.9"
5.0"	2 7/8"	MANUFACTURER'S RECOMMENDED HEIGHT	2.0"

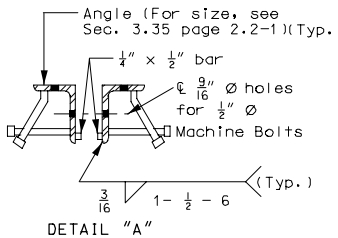
Size of Armor Angle:
Vertical leg of angle shall be a minimum of ② + 3/4 ", horizontal leg of angle shall be a minimum of 3". Minimum thickness of angle shall be 1/2"

Note: See Section 4 for appropriate notes.
For Wn and M⊥ , see Section 3.35 Page 2.1-2.

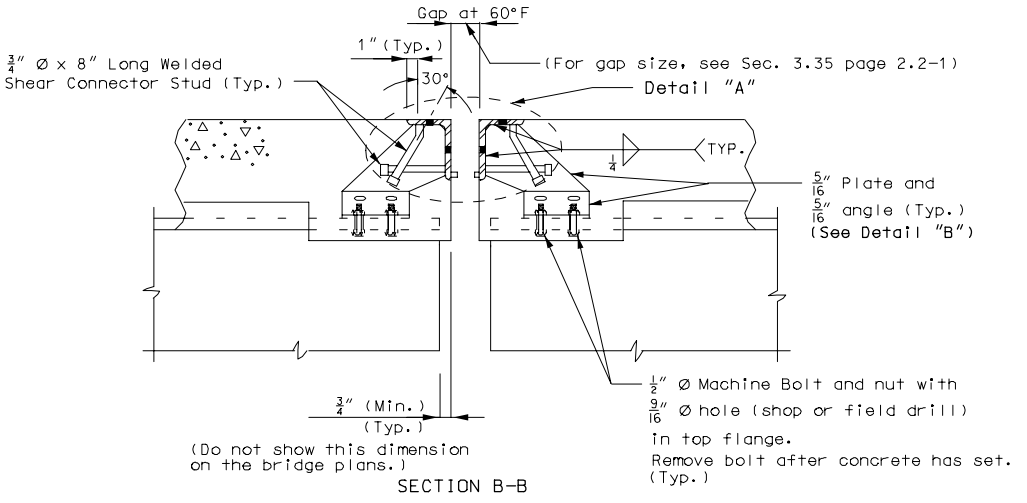

Gap at 60°F
1″ (Typ.)
30°
(For Gap Size, See Sec. 3.35 page 2.2-1)
Detail "A"
Typ. 1/4
1/4
5/16″ Plate and 5/16″ angle (See Detail "B")
Const. Joint (Top of wing)
3/4″ Ø x 8″ Long Weld Shear Connector stud (Typ.)
Const. Joint Key
Fill Face of End Bent
3/4″ (Min.) (Do not show this dimension on the bridge plans.)
1/2″ Ø Machine Bolt and Nut with 9/16″ Ø hole (Shop or field drill) in top flange. Remove bolt after concrete has set.

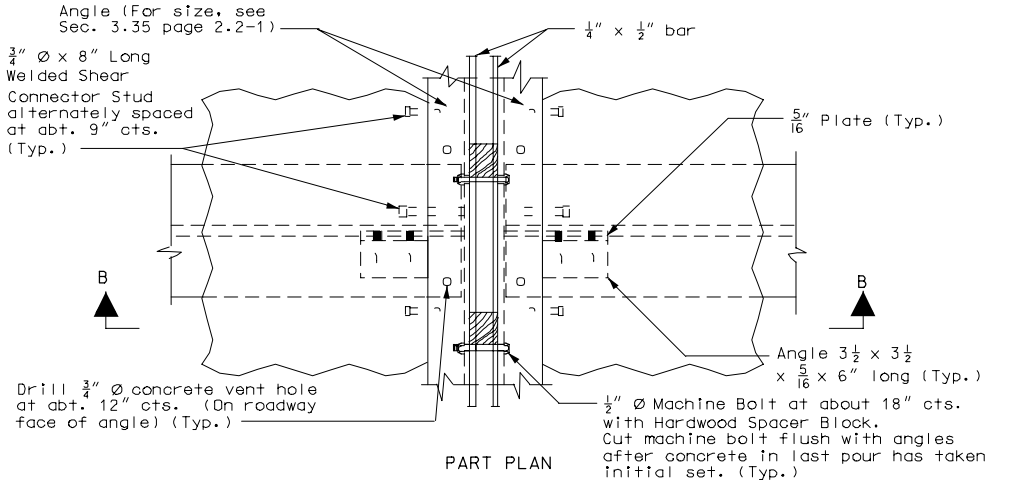

SECTION B-B
Angle (For size, see Sec. 3.35 page 2.2-1)
1/4″ x 1/2″ bar
3/4″ Ø x 8″ Long Welded Shear Connector Stud alternately spaced at abt. 9″ cts. (Typ.)
5/16″ plate
Fill Face of End Bent
B
B
Angle 3 1/2 x 3 1/2 x 5/16 x 6″ long
Drill 3/4″ Ø concrete vent hole at abt. 12″ cts. (On roadway face of angle) (Typ.)
1/2″ Ø Machine Bolt at about 18″ cts. with Hardwood Spacer Block. Cut machine bolt flush with angles after concrete in last pour has taken initial set. (Typ.)
PART PLAN

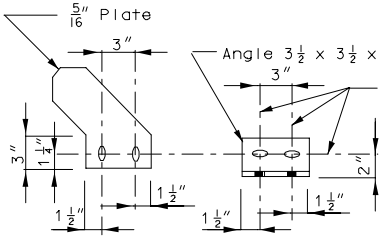

5/16″ Plate
3″
Angle 3 1/2 x 3 1/2 x 5/16 x 6″ long
3″
℄ 9/16″ x 1″ slotted holes for 1/2″ Ø Machine Bolts
3″
1 1/4″
1 1/2″
1 1/2″
2″
1 1/2″
DETAIL "B"

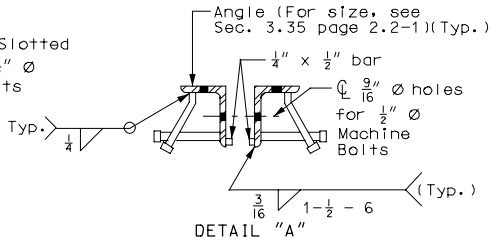

Angle (For size, see Sec. 3.35 page 2.2-1)(Typ.)
1/4″ x 1/2″ bar
℄ 9/16″ Ø holes for 1/2″ Ø Machine Bolts
(Typ.)
3/16
1- 1/2 - 6
DETAIL "A"

DETAILS AT INTERMEDIATE BENTS (STEEL STRUCTURES) **Preformed Compression Joint Seal**

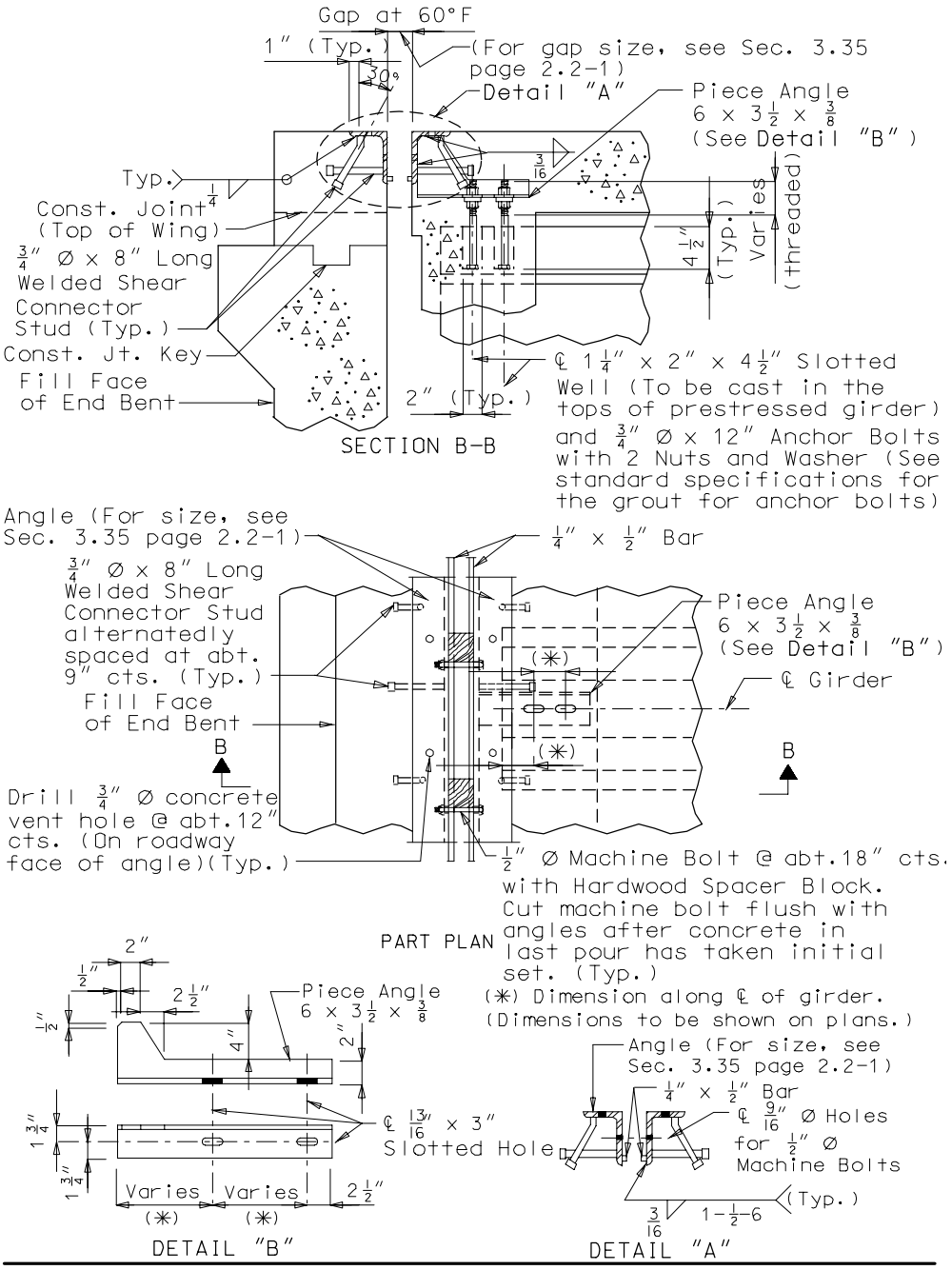






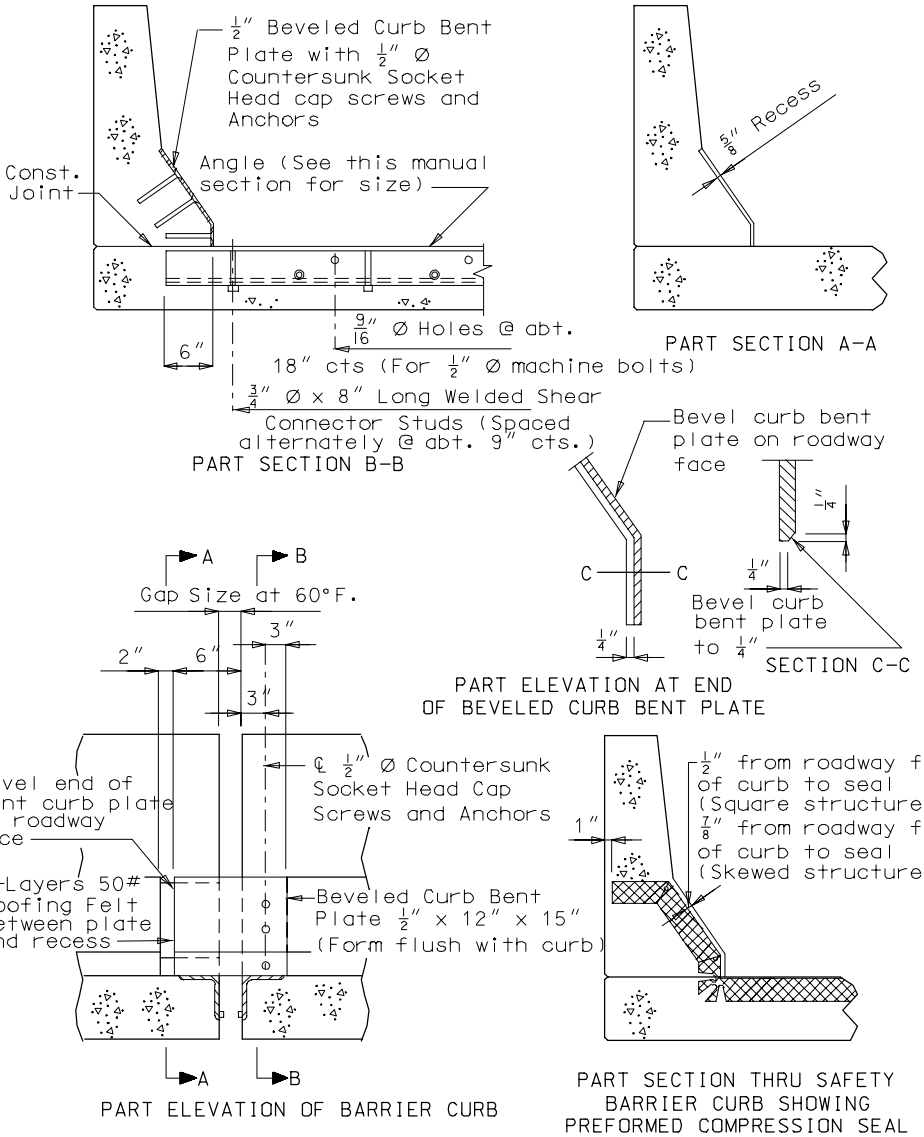


DETAILS AT END BENTS (PRESTRESSED STRUCTURES) Preformed Compression Joint Seal

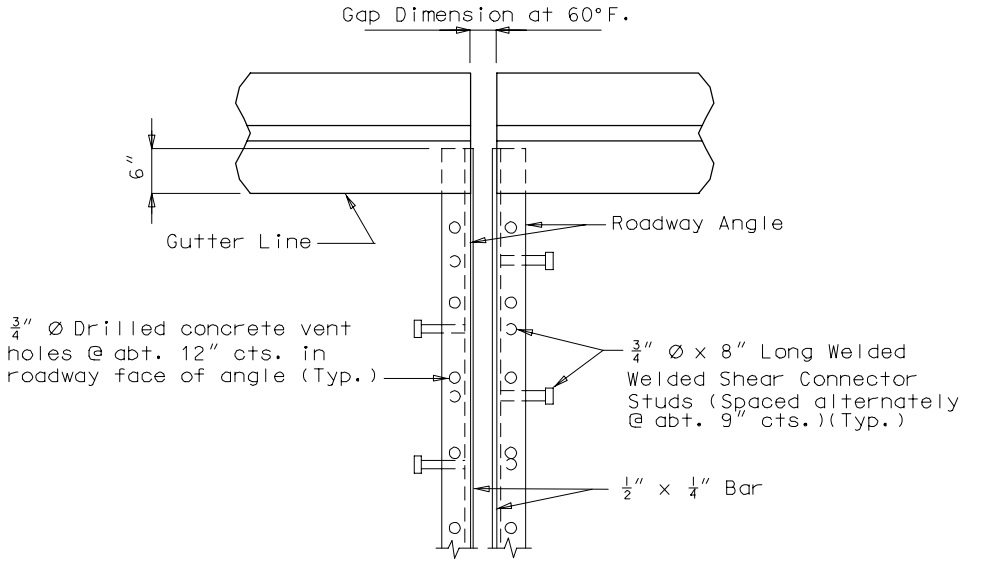


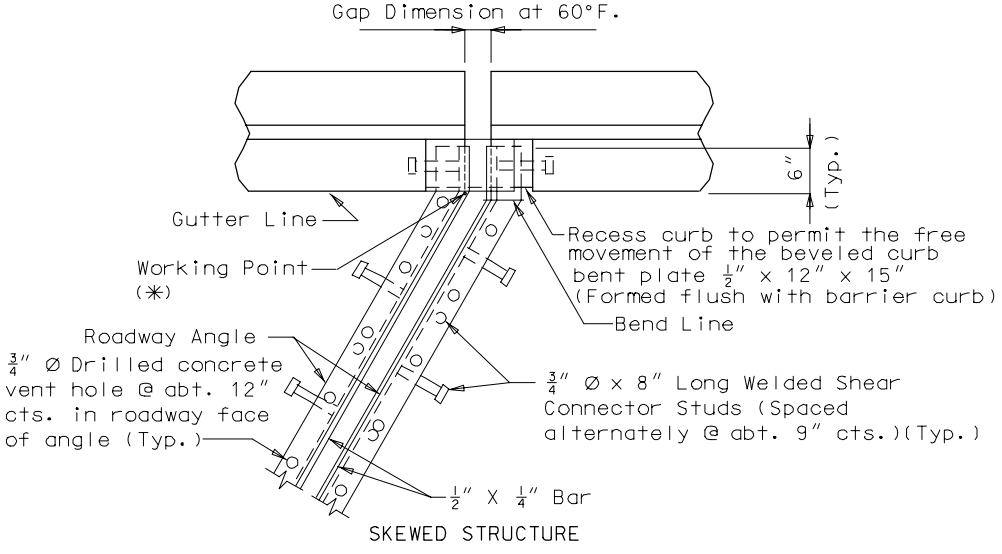
BARRIER CURB DETAILS Preformed Compression Joint Seal

Note: Do not use barrier curb plate on square structures.

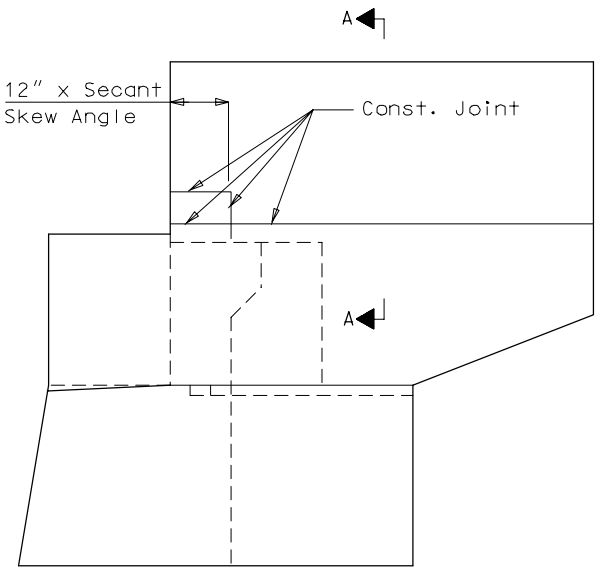


TYPICAL PART PLANS Preformed Compression Joint Seal

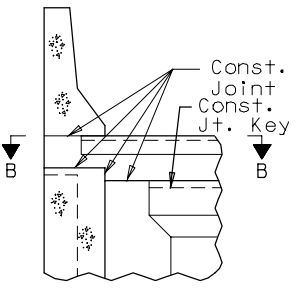




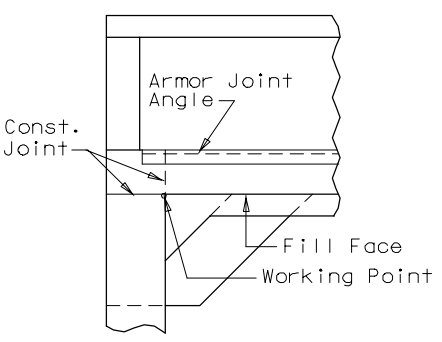
(✳) The working point is always placed on the front face side of backwall at the gutter line.



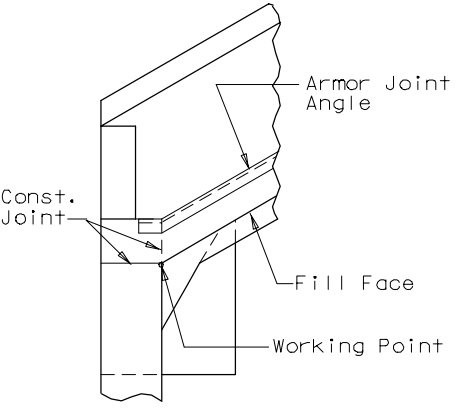
ELEVATION



PART SECTION A-A



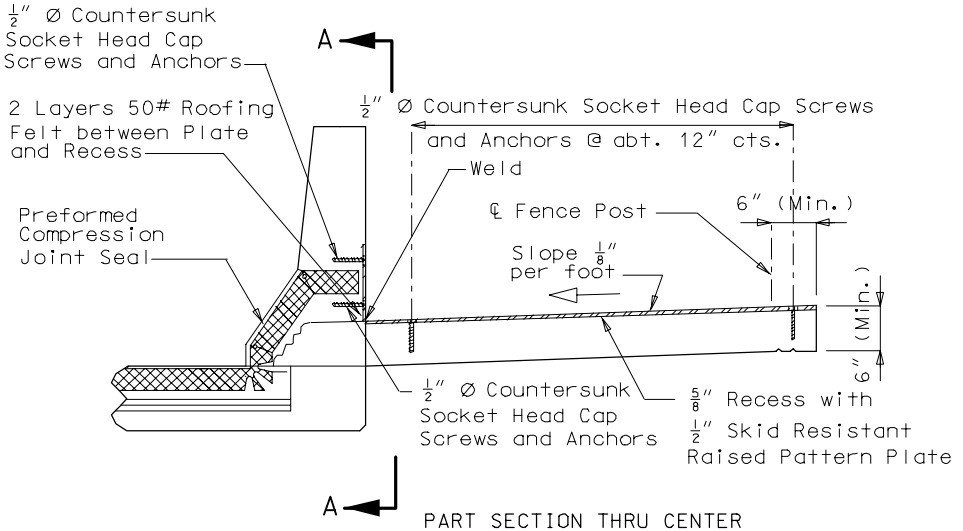
PART PLAN B-B
(SQUARE)



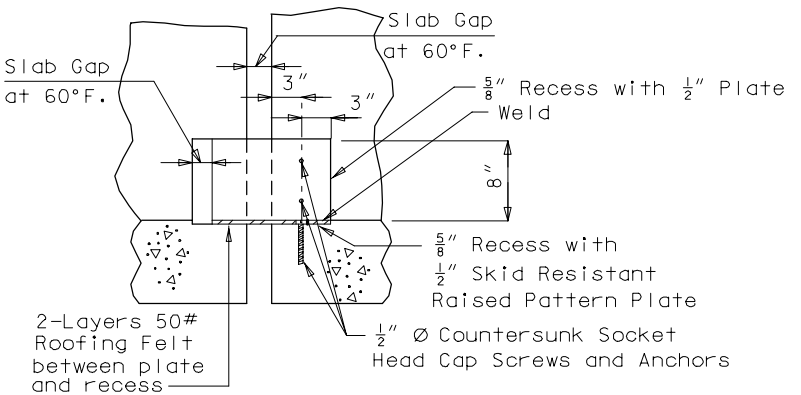
PART PLAN B-B
(SKEWED)

SIDEWALK DETAILS Preformed Compression Joint Seal

See bridge manual Section 3.30 (General Superstructure) for details and reinforcement of the sidewalk and bridge manual Section 4 (General Notes) for the appropriate notes to use on the bridge plans



PART SECTION THRU CENTER OF EXPANSION DEVICE

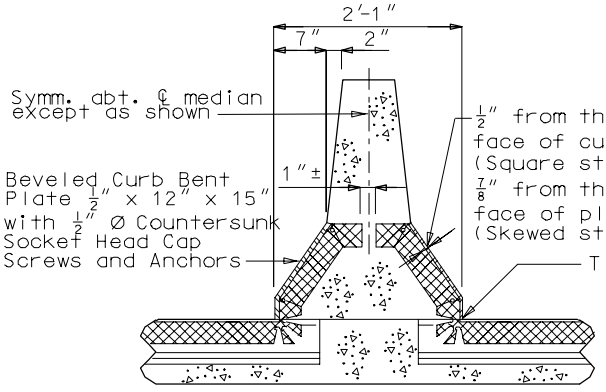


PART SECTION A-A

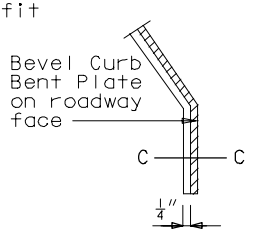
DOUBLE FACED MEDIAN BARRIER BRIDGE CURB Preformed Compression Joint Seal

Note:
Do not use barrier curb plate on square structures.

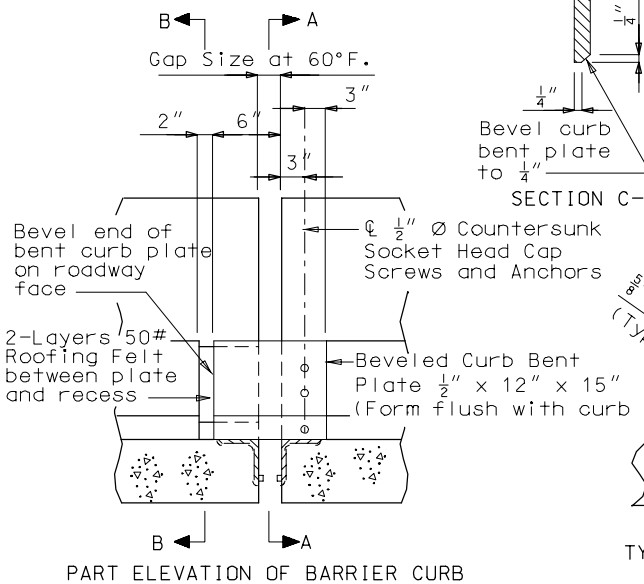
For details not shown of median barrier bridge curb, see the safety barrier curb details (General Superstructure Section of Bridge Manual), Design Division Standard Drawings (Concrete Median Barrier) and Bridge Design Layout.



TYPICAL PART SECTION A-A

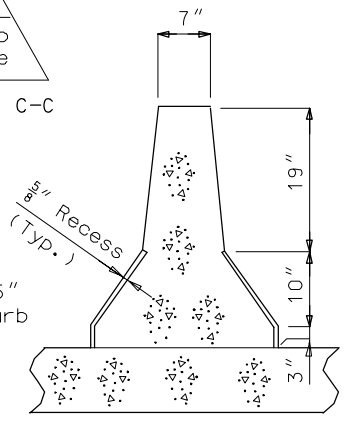


PART ELEVATION AT END OF BEVELED CURB BENT PLATE



PART ELEVATION OF BARRIER CURB

SECTION C-C



TYPICAL PART SECTION B-B

Check the Design Layout for the type of expansion device to be used. If no expansion device is specified, but due to the length of the structure an expansion device is indicated, then consult the Structural Project Manager for the type to be used.

The flat plate expansion device will be used within the limits described below.

LINEAR EXPANSION AND CONTRACTION

Coefficient of Linear Expansion, α

Concrete structure: α = 0.000006 ft/ft/°F
Steel structure: α = 0.0000065 ft/ft/°F

SKEW

Any angle.

TEMPERATURE RANGE FROM 60°F	Rise	Fall	Range
Concrete Structure;	50°F	70°F	120°F
Steel Structure;	60°F	80°F	140°F

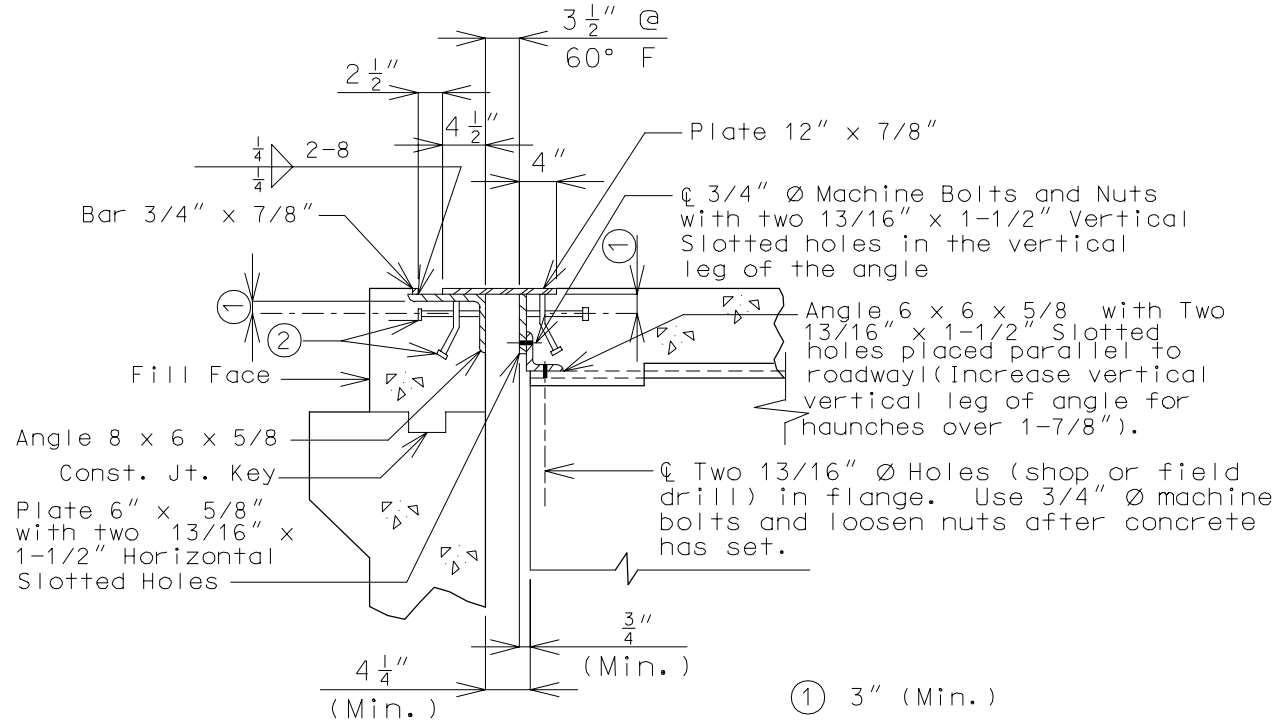
Movement for a 10°F change in temperature should be indicated on the plans to the nearest 1/16" by using note (H5.22) in Section 4.

The movement for a 10°F change in temperature = α x 10°F x Actual Expansion Length x Cosine of the Skew Angle.

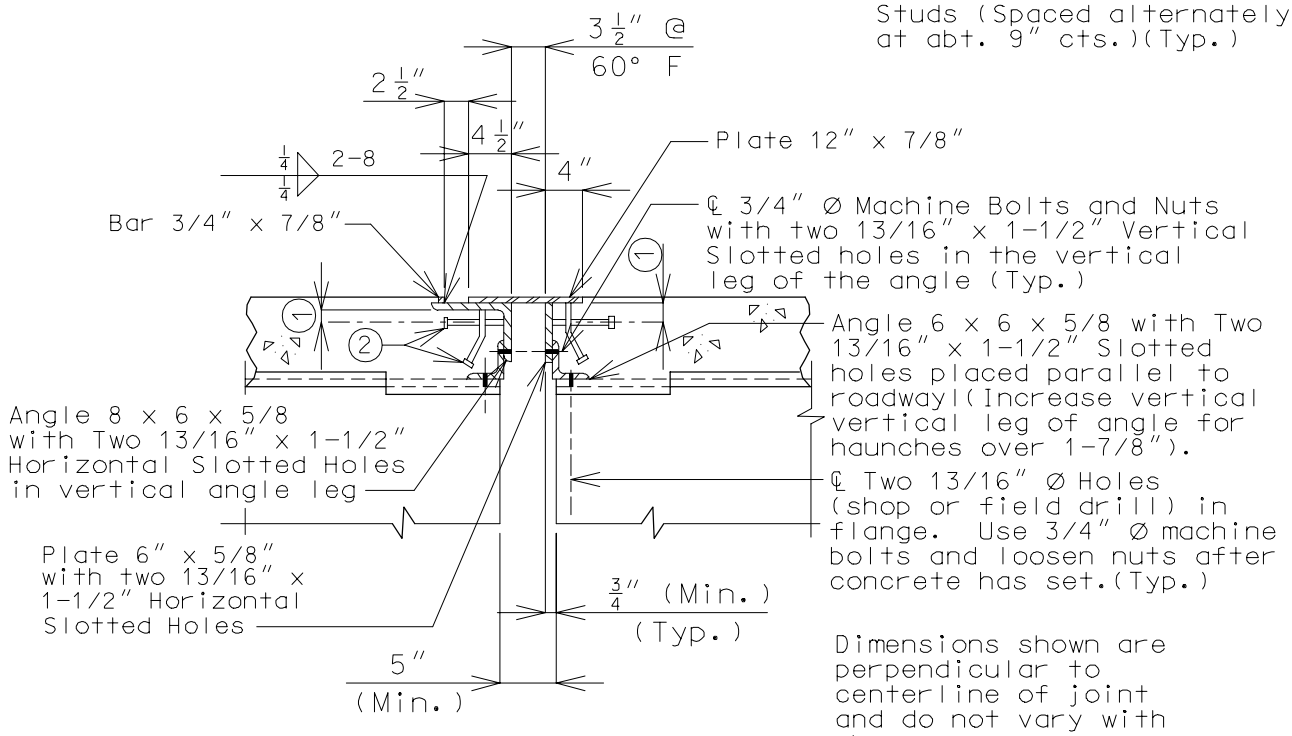
EXPANSION LENGTH		GAP AT 60°F
STEEL	CONCRETE	
262.5'	325.0'	3-1/2"

Note:
See Bridge Manual Section 4, Page H5-C for the appropriate notes.

DETAILS (STEEL STRUCTURES) **Flat Plate Expansion Devices**



PART SECTION AT END BENT

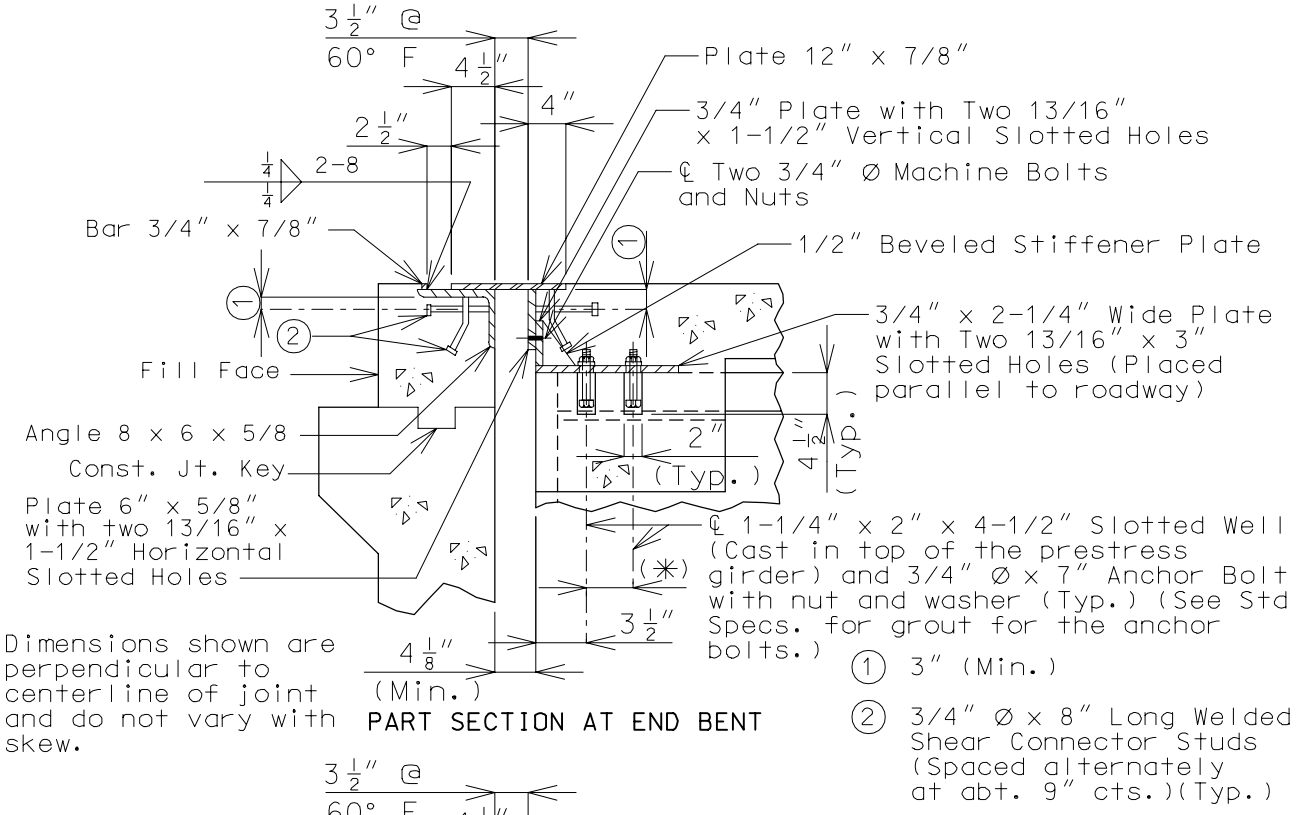


PART SECTION AT INTERMEDIATE BENT

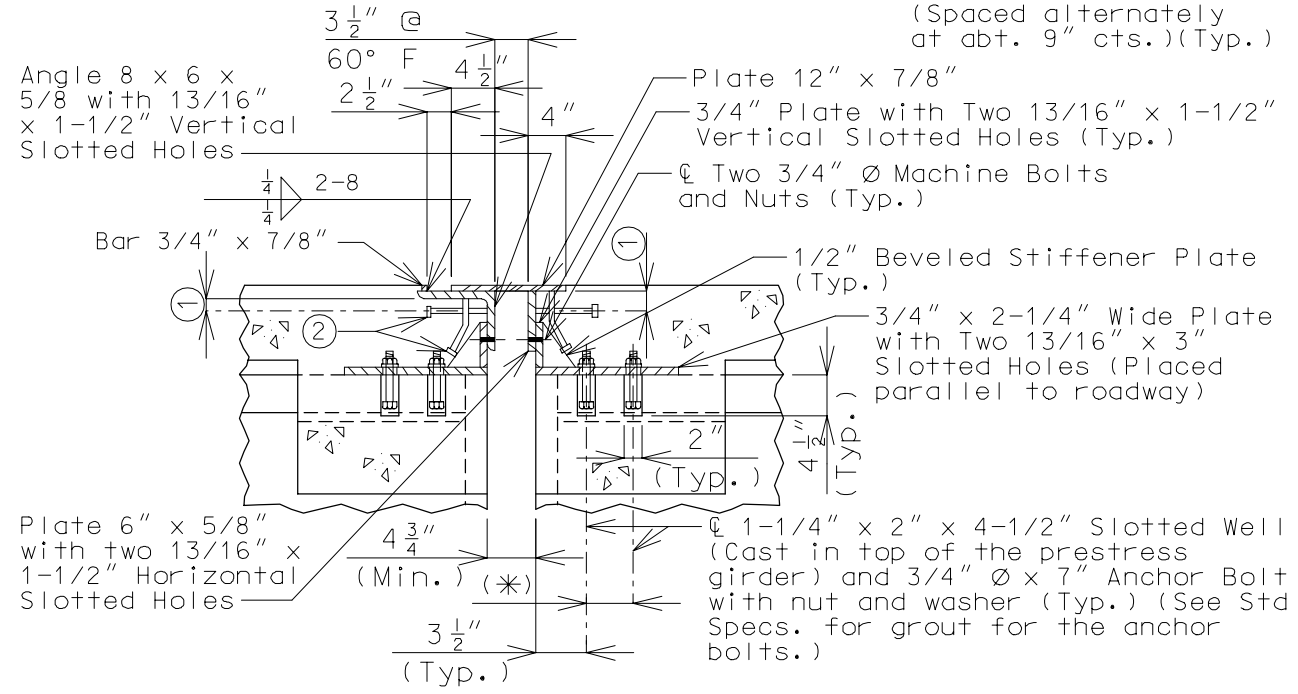
Notes:
Part longitudinal sections for bridges on grades or vertical curves having a plate type intermediate expansion device shall be detailed with the expansion plate anchor to the long span side. If equal spans, then place expansion plate anchor on the high side. For bevel plate and permissible field splice details, see this manual section.

DETAILS (PRESTRESSED STRUCTURES)

Flat Plate Expansion Devices



PART SECTION AT END BENT



PART SECTION AT INTERMEDIATE BENT

Notes:

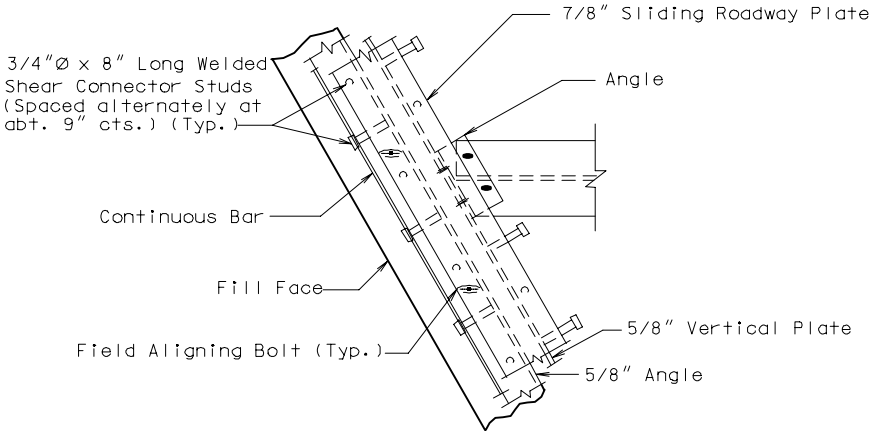
For bevel plate and permissible field splice details, see this manual section, page 3.5-1 & 3.6-1.

Part longitudinal sections for bridges on grades or vertical curves having a plate type intermediate expansion device shall be detailed with plate anchor to the long span. If equal spans, then place expansion plate anchor on the high side.

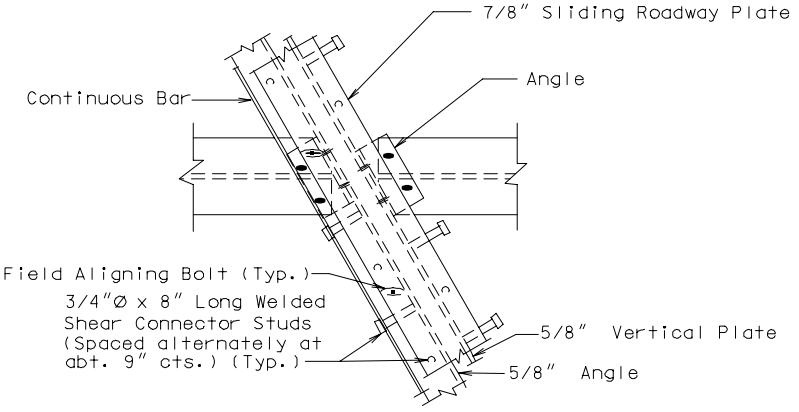
(*) Spaced between prestress girder reinforcing bars.

TYPICAL PART PLAN DETAILS
(STEEL STRUCTURES)

Flat Plate Expansion Devices



PART PLAN AT END BENT

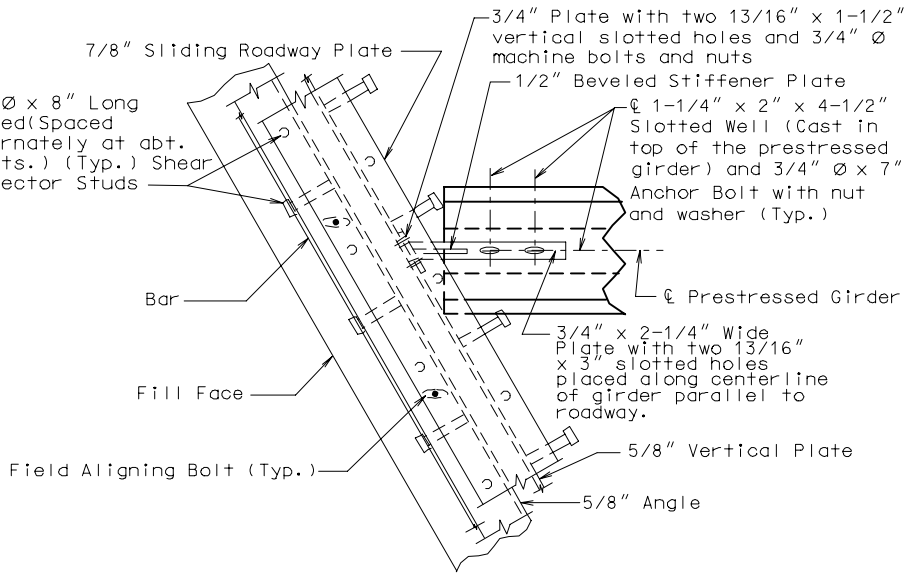


PART PLAN AT INTERMEDIATE BENT

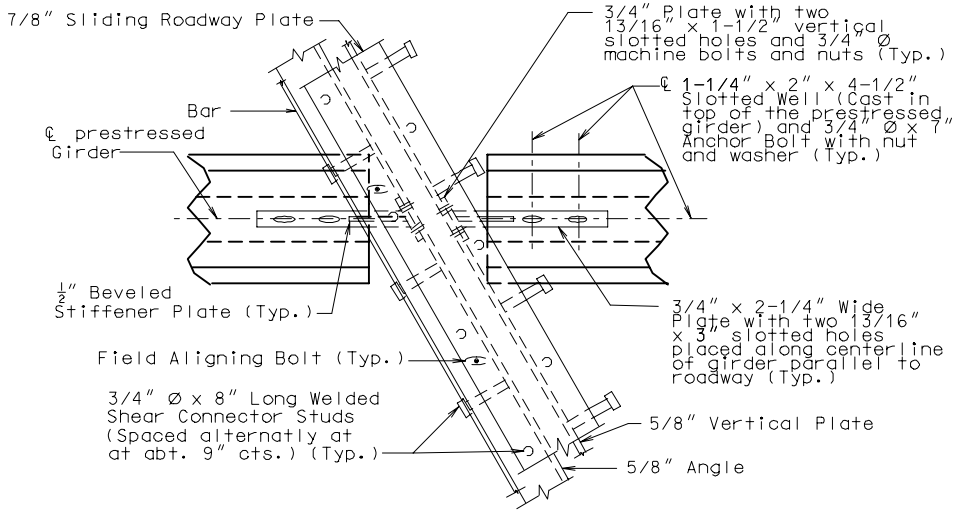
Note: Vent holes not shown for clarity.

TYPICAL PART PLAN DETAILS (CONT.)
(PRESTRESSED STRUCTURES)

Flat Plate Expansion Devices



PART PLAN AT END BENT

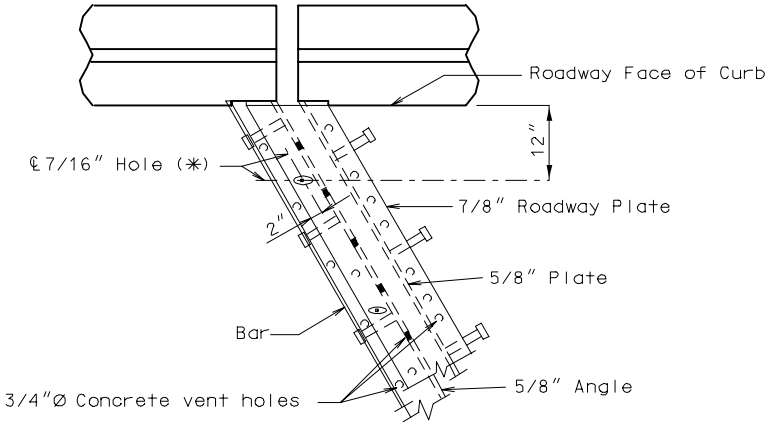


PART PLAN AT INTERMEDIATE BENT

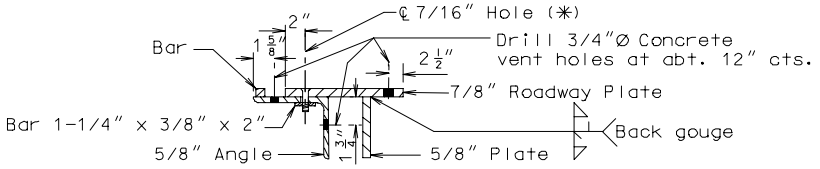
Note:
For structures skewed 40° and over, consider clipping the end of the prestressed girder. Concrete vent holes not shown for clarity.

TYPICAL ALIGNING BOLT & BEVEL PLATE DETAILS

Flat Plate Expansion Devices



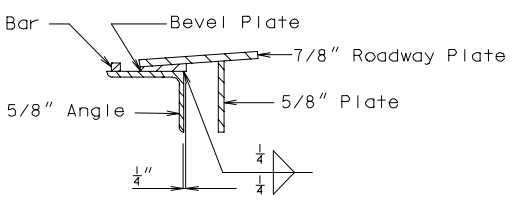
PART PLAN



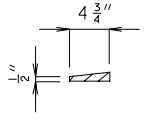
PART SECTION
(TYPICAL)

(✳) 7/16" Ø Hole, countersunk in the roadway plate; with slotted hole 1/2" x 1" in the angle; and the bar 1-1/4" x 3/8" x 2" tapped for 3/8" Ø flat head stove bolt at about 4'-0" cts. Remove bolt after concrete has set.
Offset vertical and horizontal concrete vent holes in 5/8" angle (Do not alternate)

TYPICAL BEVEL PLATE



PART SECTION
(TYPICAL)



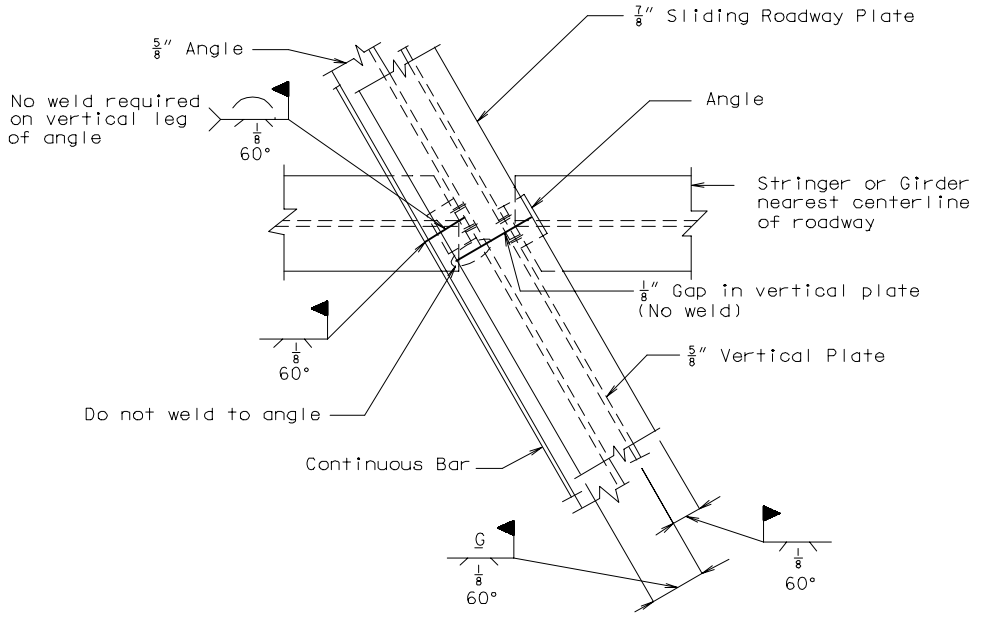
TYPICAL BEVEL PLATE

Note:
Use the bevel plate (At the end bents only) when the grade of the slab is 3.0% or more plate is required.

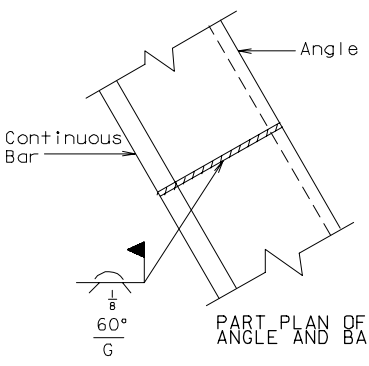
Modify the roadway plate, the 5/8" vertical plate and the continuous bar when the bevel plate is required.

TYPICAL FIELD SPLICE DETAILS

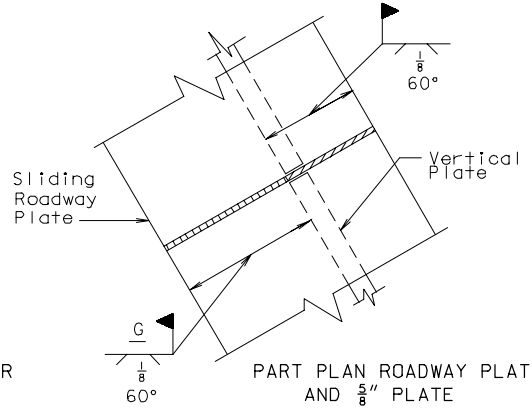
Flat Plate Expansion Devices



PART PLAN



PART PLAN OF ANGLE AND BAR

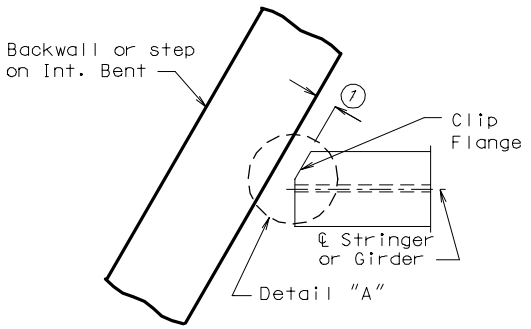


PART PLAN ROADWAY PLATE AND 5/8" PLATE

Note:

If the expansion device length is over 50 feet, splicing is permissible.

Details for a steel structure shown, prestress details are similar.



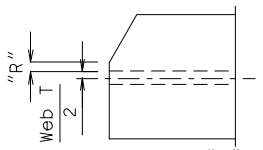
PART PLAN AT BACKWALL

① Expansion Device:
Top Flange = Expansion Device Gap plus $\frac{3}{4}$" min.
Bottom Flange = Expansion Device Gap Min.

No Expansion Device:
Bottom Flange = 2" min.
Do not clip top flange

Stepped Int. Bent:
Top and/or Bottom = 2" min.

Note:
Clip of top and bottom flanges need not be the same.

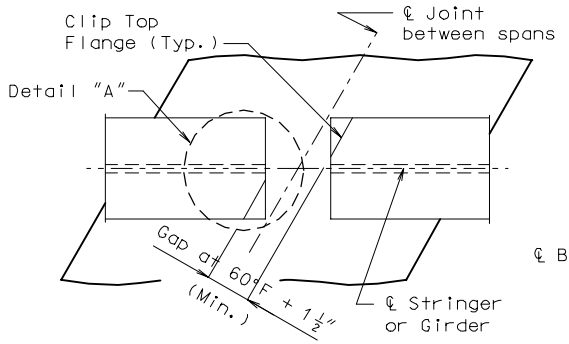


DETAIL "A" (TYPICAL)

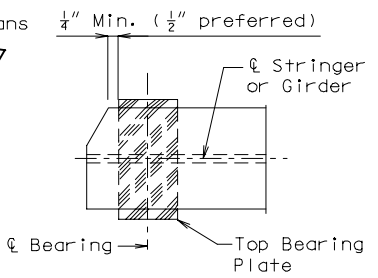
Note:
"R" = $\frac{1}{2}$" (Min.) For plate girder structures.

TABLE FOR "R" - WIDE FLANGE BEAMS						
Nominal Flange Width (✳)	$8\frac{1}{4}$"	9"	10"	$10\frac{1}{2}$"	$11\frac{1}{2}$"	12"
"R"	0.54"	0.54"	0.64"	0.70"	0.75"	0.80"

✳ Note: For wide flange beams with flange widths other than those shown refer to AISC Steel Construction Manual for "R".

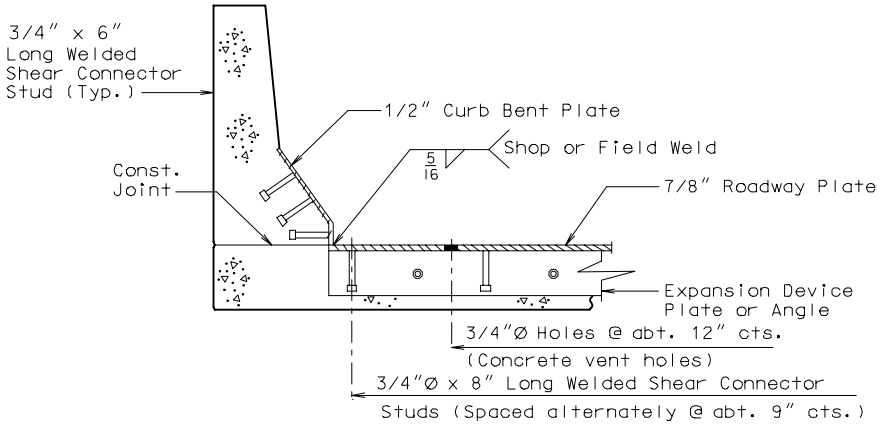


STRINGER OR GIRDER INTERMEDIATE BENTS

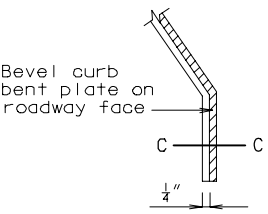


STRINGER OR GIRDER WITH BEARING AT END BENTS

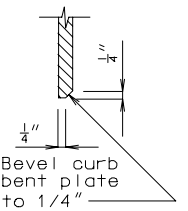
Note:
Details for a steel structure shown, details for a prestress structure similar.



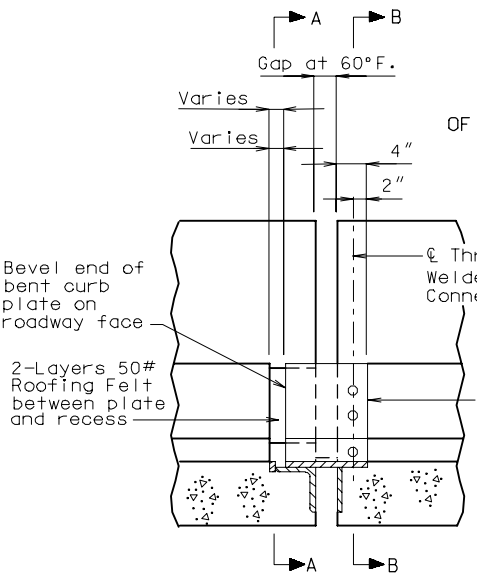
SECTION B-B



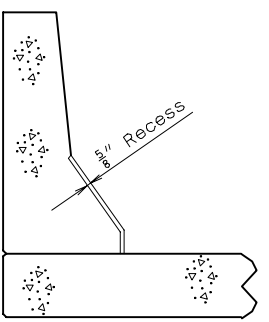
PART ELEVATION AT END
OF BEVELED CURB BENT PLATE



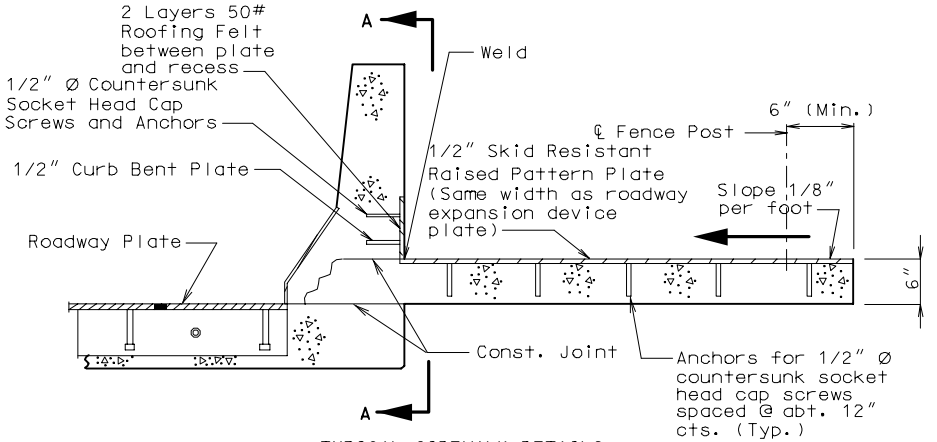
SECTION C-C



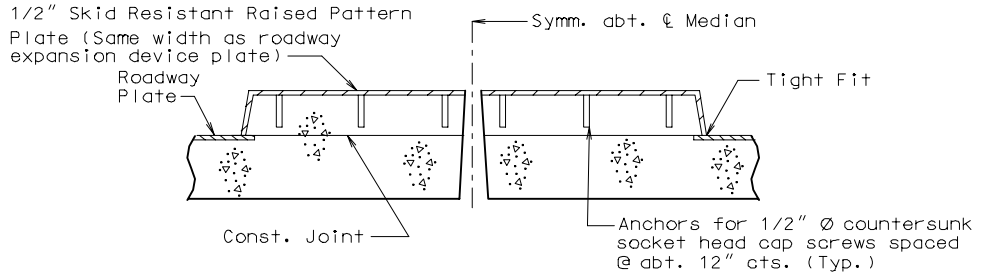
ELEVATION OF BARRIER CURB



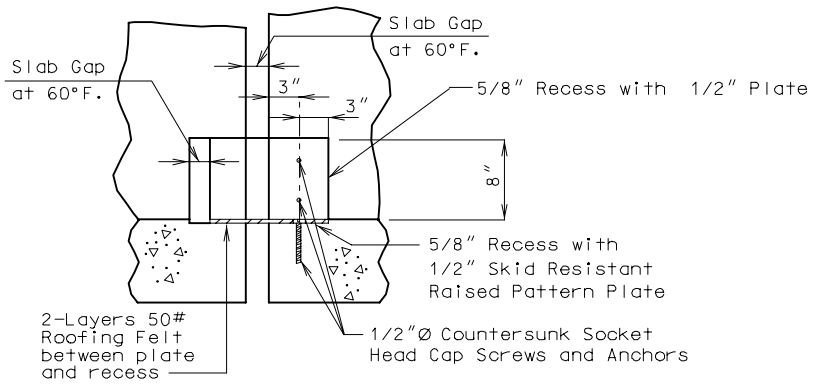
PART SECTION A-A



TYPICAL SIDEWALK DETAILS



TYPICAL MEDIAN DETAILS



PART SECTION A-A

Check the Design Layout for the type of expansion device to be used. If no expansion device is specified, but due to the length of the structure an expansion device is indicated, consult the Structural Project Manager for the type to be used.

Each finger plate expansion device will be used within the limits described below.

LINEAR EXPANSION AND CONTRACTION

Coefficient of Linear Expansion, α

Concrete structure $\alpha = 0.000006$ ft/ft/°F
Steel structure $\alpha = 0.0000065$ ft/ft/°F

SKEW

Any angle.

TEMPERATURE RANGE FROM 60°F.:	Rise	Fall	Range
Concrete Structure;	50°	70°	120°
Steel Structure;	60°	80°	140°

Movement for a 10°F change in temperature should be indicated on the plans to the nearest $\frac{1}{16}$" by using note (H5.2) in Section 4.

The movement for a 10°F change in temperature = (Coefficient of Expansion)x(10°F)x(Actual Expansion Length).

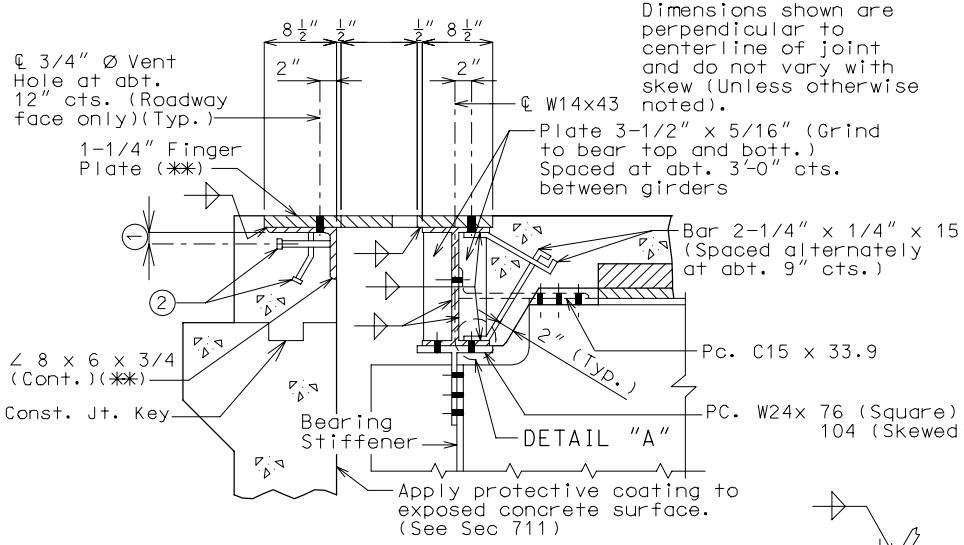
MAX. LENGTH OF EXP.		TOTAL MOVEMENT	GAP AT 60°F
CONC.	STEEL		
500'	400'	4"	2-7/8"
820'	650'	6-1/2"	4"

Note:
See Bridge Manual Section 4 pages H5-A & H5-B for the appropriate notes.

DETAILS AT END BENT

Finger Plate Expansion Devices

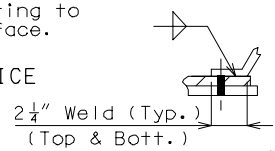
Dimensions shown are perpendicular to centerline of joint and do not vary with skew (Unless otherwise noted).

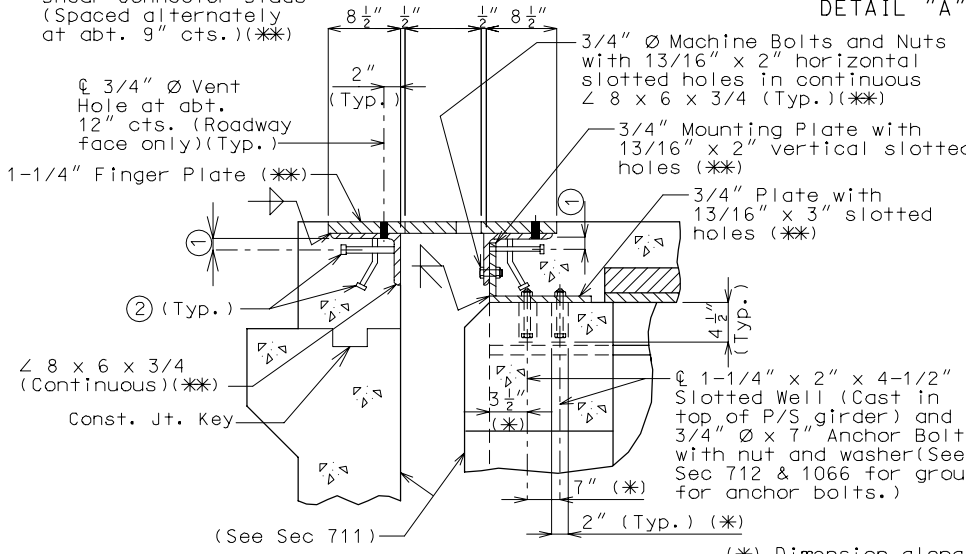


PART SECTION THRU EXPANSION DEVICE
(Steel Structure)

① 3" (Min.)

② 3/4" Ø x 8" Long Welded Shear Connector Studs (Spaced alternately at abt. 9" cts.)(**)





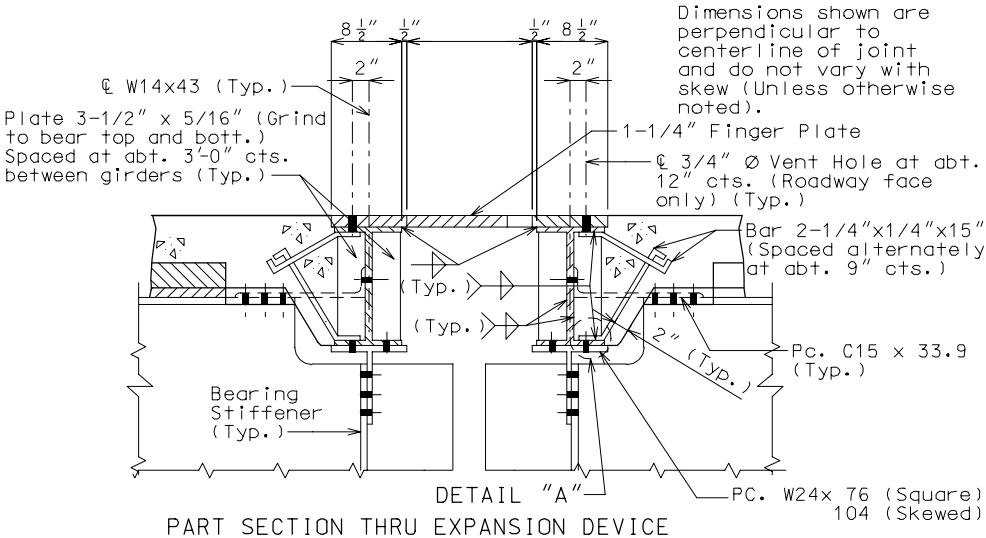
PART SECTION THRU EXPANSION DEVICE
(Prestressed Structure)

(*) Dimension along ℄ Girder

(**) When distance "A" or "D" shown on page 4.4-1 is greater than 9" or 12", respectively, then the details of supporting angles, mounting plates, shear studs and finger plate thickness need to be specially designed. Mounting Plates shall not be less than supporting angle in thickness.

DETAILS AT INT. BENT

Finger Plate Expansion Devices

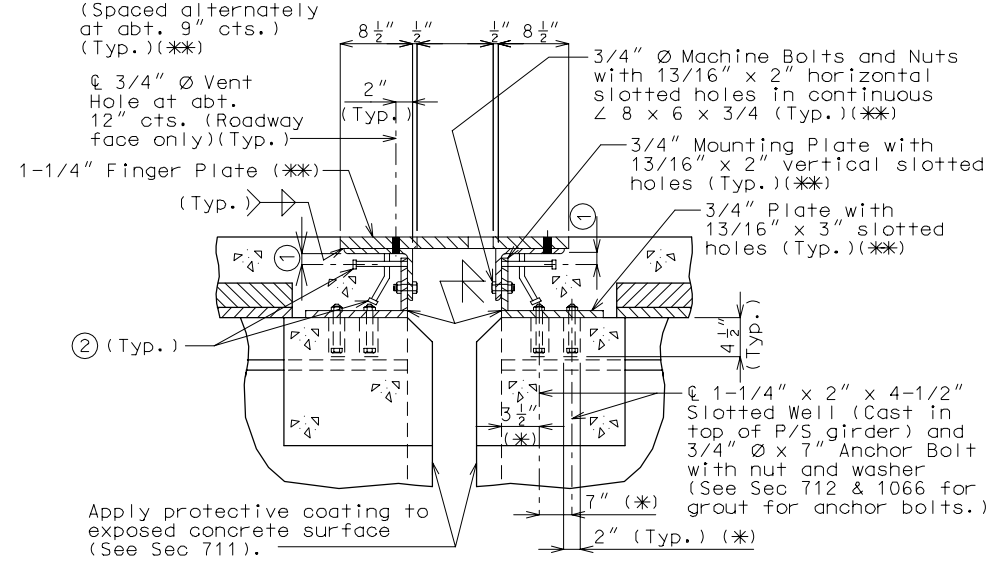


PART SECTION THRU EXPANSION DEVICE (Steel Structure)

① 3" (Min.)

② 3/4" Ø x 8" Long Welded Shear Connector Studs (Spaced alternately at abt. 9" cts.) (Typ.)(✱✱)

Note: for Details "A" see Sec. 3.35, Page 4.3-1.



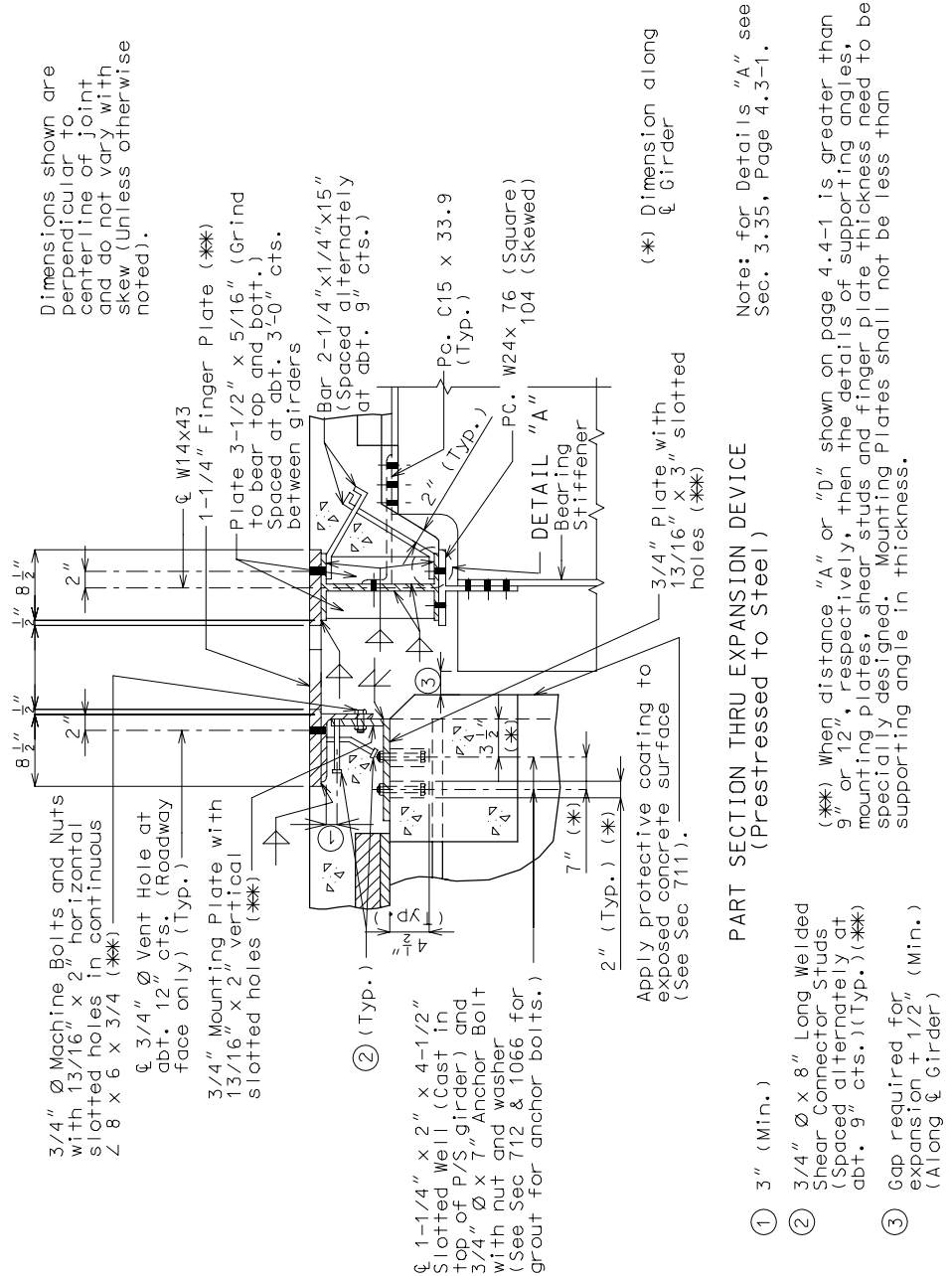
PART SECTION THRU EXPANSION DEVICE (Prestressed Structure)

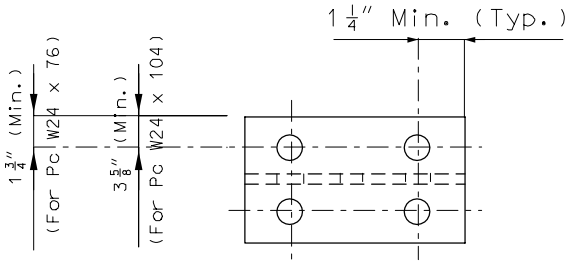
(✱) Dimension along ℄ Girder

(✱✱) When distance "A" or "D" shown on page 4.4-1 is greater than 9" or 12", respectively, then the details of supporting angles, mounting plates, shear studs and finger plate thickness need to be specially designed. Mounting Plates shall not be less than supporting angle in thickness.

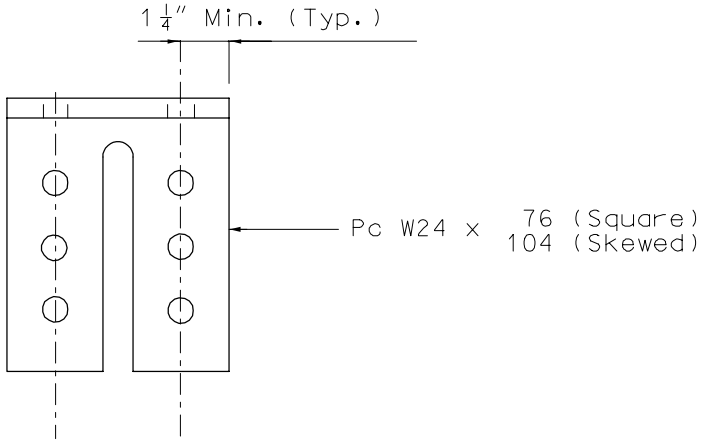
DETAILS AT INT. BENT (PRESTRESSED TO STEEL)

Finger Plate Expansion Devices





PLAN



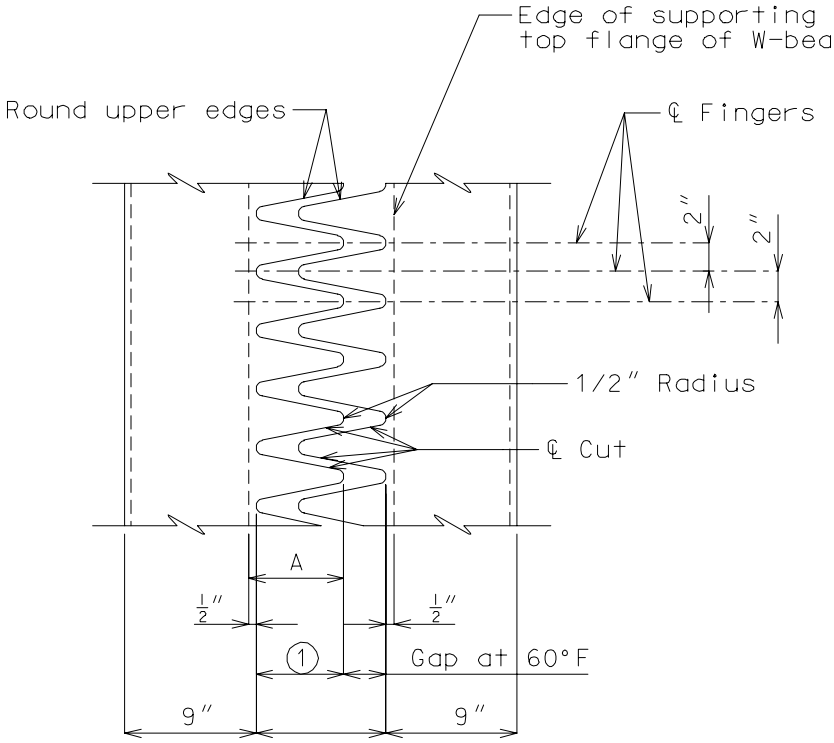
ELEVATION OF PIECE W24 x 76 (SQUARE) 104 (SKEWED)

Note:

Place the above details near "Part Section Thru Expansion Device For Finger Plates".

All holes shown for connections to be subpunched 11/16" Ø (shop or field drill) and reamed to 13/16" Ø in field.

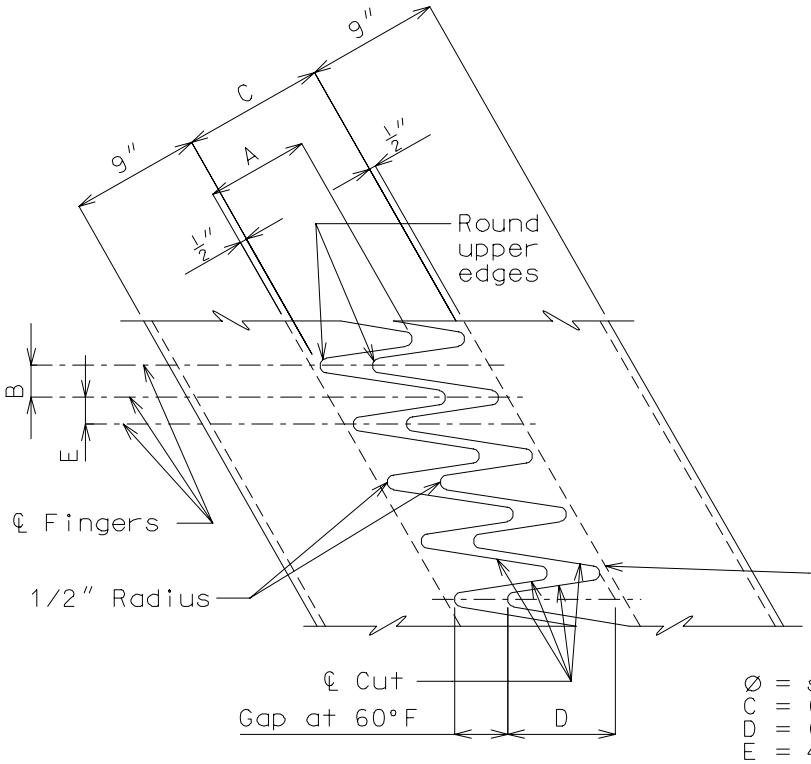
TYPICAL PLAN OF PLATE **Finger Plate Expansion Devices**



TYPICAL PLAN OF PLATE
(SQUARE)

4" MOVEMENT		
Skew Angle	A	B
1° - 5°	6-1/2"	2"
6° - 15°	6-1/2"	2-1/16"
16° - 26°	6-1/2"	2-1/8"
27° - 38°	6-1/2"	2-3/16"
39° - 47°	6"	2-1/4"
48° - 50°	6"	2-5/16"
51° - 55°	5-1/2"	2-5/16"
56° - 58°	5-1/2"	2-3/8"
59° - 60°	5"	2-3/8"

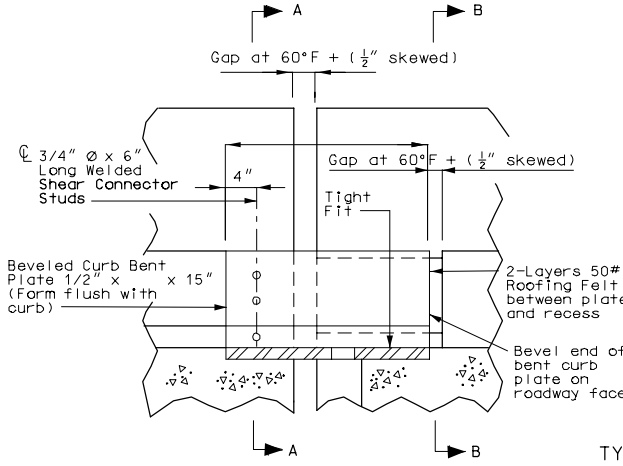
(1) 6" for 4" Movement
8-1/2" for 6-1/2" movement



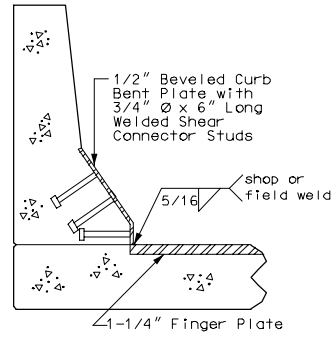
6-1/2" MOVEMENT		
Skew Angle	A	B
1° - 7°	9"	2"
8° - 22°	9"	2-1/16"
23° - 28°	9"	2-1/8"
29° - 36°	8-1/2"	2-1/8"
37° - 38°	8-1/2"	2-3/16"
39° - 45°	8"	2-3/16"
46° - 47°	7-1/2"	2-3/16"
48° - 51°	7-1/2"	2-1/4"
52° - 57°	7"	2-1/4"
58° - 60°	6-1/2"	2-5/16"

Ø = skew angle
C = (A - 0.5")+[(Gap @ 60°F) cos Ø]
D = (A - 0.5") sec Ø
E = 4" - B

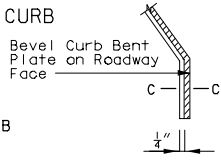
TYPICAL PLAN OF PLATE
(SKEWED)



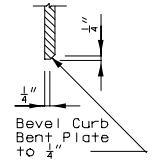
PART ELEVATION OF BARRIER CURB (END BENT)



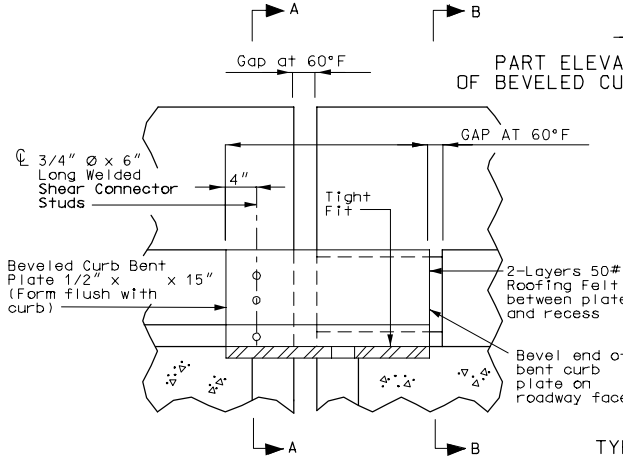
TYPICAL PART SECTION A-A



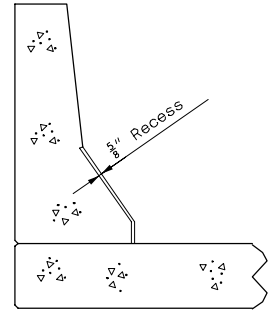
PART ELEVATION AT END OF BEVELED CURB BENT PLATE



SECTION C-C

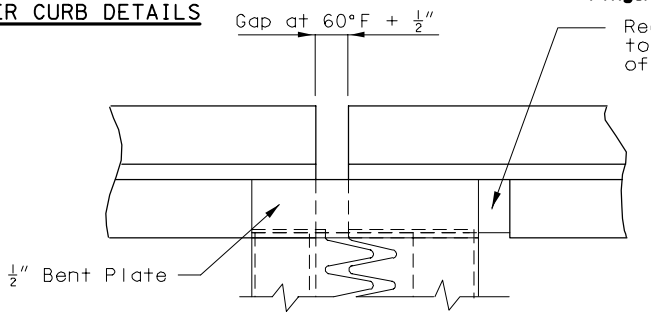


PART ELEVATION OF BARRIER CURB (INTERMEDIATE BENT)

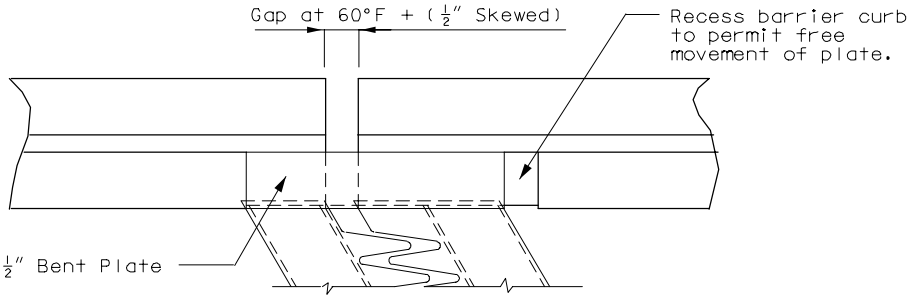


TYPICAL PART SECTION B-B

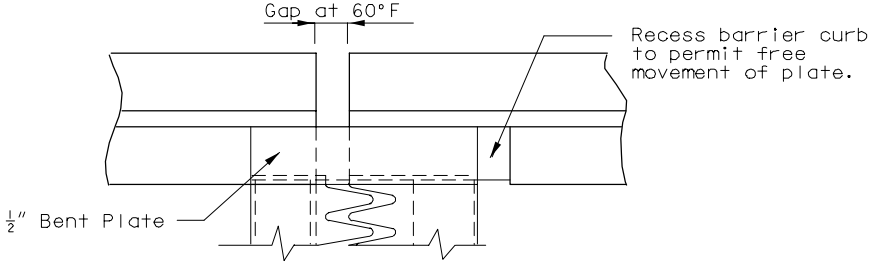
BARRIER CURB DETAILS



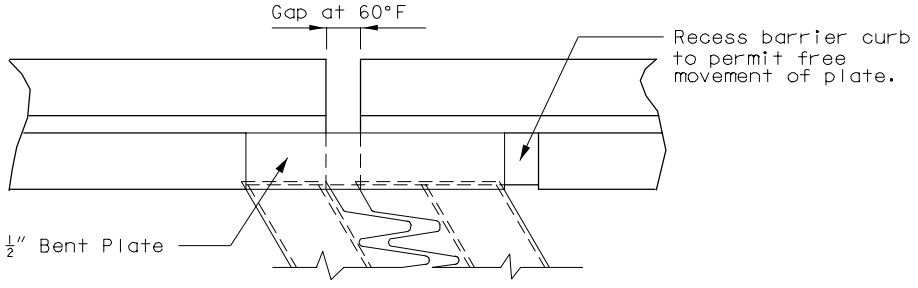
PART PLAN OF CURB AT END BENT (SQUARE)



PART PLAN OF CURB AT END BENT (SKEWED)

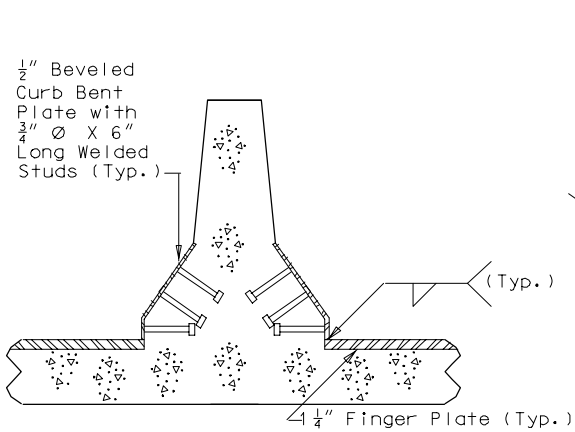


PART PLAN OF CURB AT INT. BENT (SQUARE)

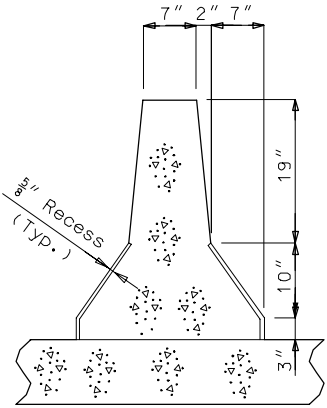


PART PLAN OF CURB AT INT. BENT (SKEWED)

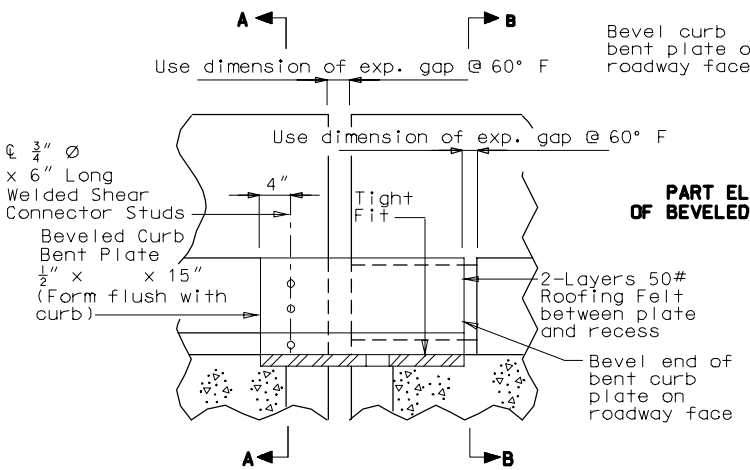
For the details not shown of median barrier bridge curb, see the safety barrier curb details (General Superstructure Section of the Bridge Design Manual), the Design Division Standard Drawings (Concrete median barrier), and the Bridge Design Layout.



TYPICAL PART SECTION A-A

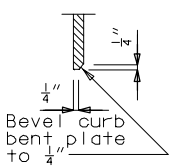


TYPICAL PART SECTION B-B

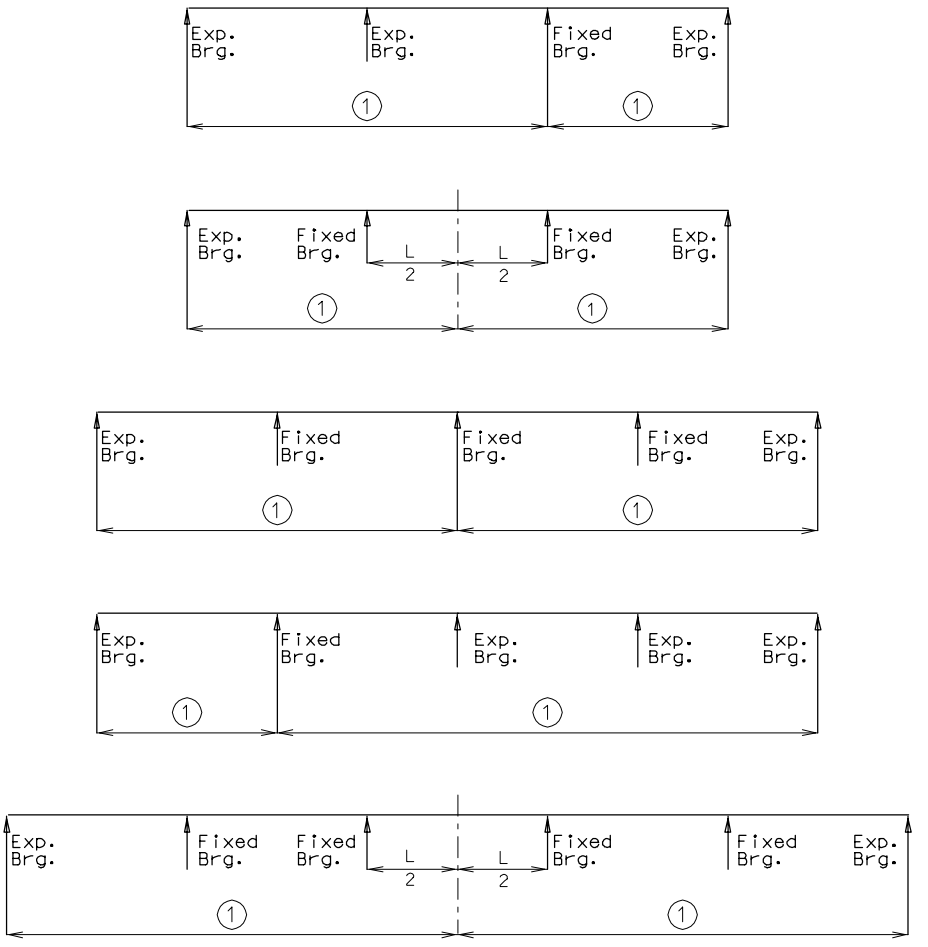


PART ELEVATION OF BARRIER CURB (INTERMEDIATE BENT)

PART ELEVATION AT END OF BEVELED CURB BENT PLATE



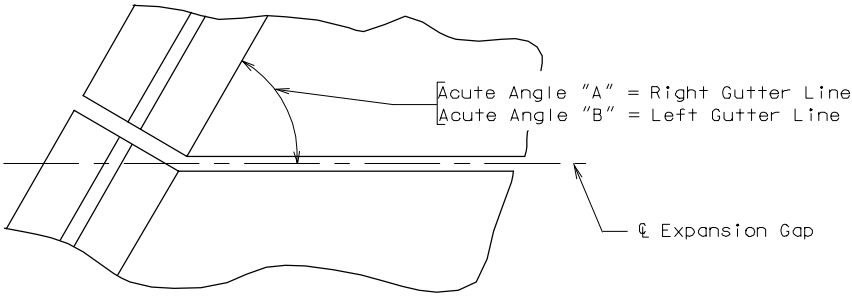
SECTION C-C



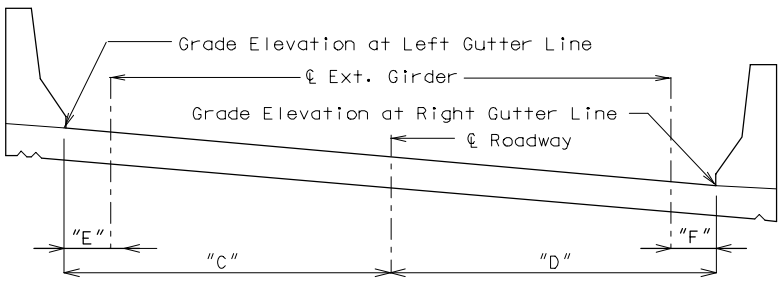
Note:

(1) = Expansion and contraction length.

For configurations not shown, a temperture force distribution analysis may be necessary to estimate the point of thermal origin.



PART PLAN



SECTION THRU ℄ EXPANSION GAP

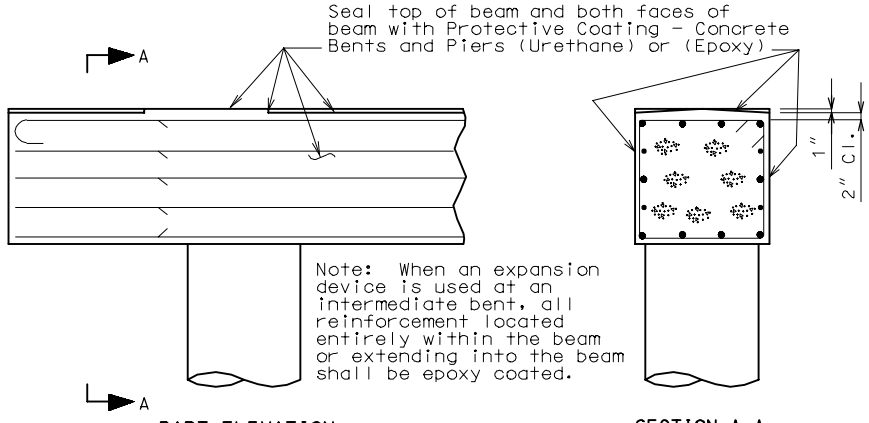
BENT NO.	GRADE ELEVATION			ANGLE		HORIZONTAL DIMENSION			
	LEFT GUTTER LINE	℄ RDWY.	RIGHT GUTTER LINE	"A"	"B"	"C"	"D"	"E"	"F"

Note: Add the Section Thru ℄ Expansion Gap and the table shown above to the Expansion Device sheet for skewed curved structures.

DETAILS OF SUBSTRUCTURE PROTECTION FOR ALL EXPANSION DEVICES Miscellaneous

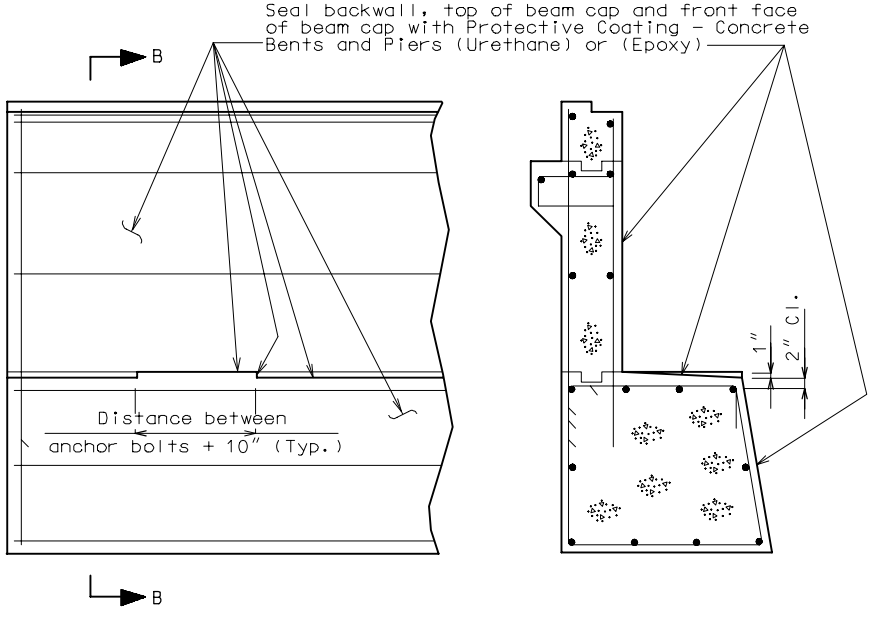
Note:

A protective coating shall be applied to concrete surfaces exposed to drainage from the roadway. Indicate surface to be coated on plans. Urethane resembles black tar which is to be used where aesthetics is not a concern, otherwise use epoxy.



PART ELEVATION SECTION A-A

Note:
Slope beam cap to drain between bearings.
See appropriate section for bar size and details not shown.



PART ELEVATION SECTION B-B

Note:
Epoxy coat all reinforcement in end bents with expansion devices.

GENERAL

Check the Design Layout for type of expansion device to be used. If no expansion device is specified, but due to the length of the structure an expansion device is indicated, consult the Structural Project Manager for type to be used.

LINEAR EXPANSION AND CONTRACTION:

Coefficient of Linear Expansion, α

Concrete Structure: $\alpha = 0.000006$ ft/ft/°F

Steel Structure: $\alpha = 0.0000065$ ft/ft/°F

TEMPERATURE RANGE FROM 60°F	Rise	Fall	Range
Concrete Structure:	50°F	70°F	120°F
Steel Structure:	60°F	80°F	140°F

Movement for a 10°F change in temperature should be indicated on the plans to the nearest 1/16″ by using note (Hx.xx) in Section 4.

The movement for a 10°F change in temperature = α x 10°F x Actual Expansion Length x Cosine of the Skew Angle.

GENERAL (CONT.)

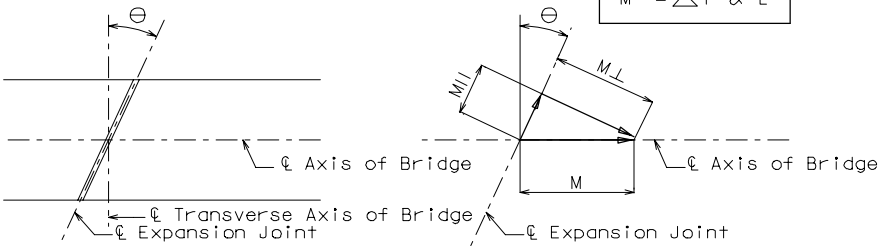
Typical calculations for skew solution.

FORMULAE

$M\perp = M \cos\Theta$

$M\parallel = M \sin\Theta$

$M = \triangle T \propto L$



GIVEN: Total bridge movement along the centerline of bridge has been calculated at 1.08".

∴ M = 1.08"

FIND: The proper seal at the skew angle $\Theta = 30°$ and with the joint opening at 60°F.

Θ = Skew Angle of Expansion Joint.

M = Total Movement of Bridge.

$M\perp$ = Total Movement Perpendicular to Joint.

SOLUTION:

Step 1: Calculate the total movement $\perp$ to the joint.

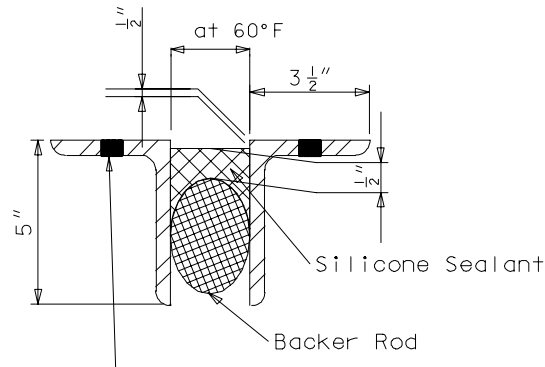
$M\perp = M \cos\Theta$

$= 1.08" \times 0.866$

$= 0.935"$ Required Sealant Movement Range

$0.935" \leq 2"$ max. movement

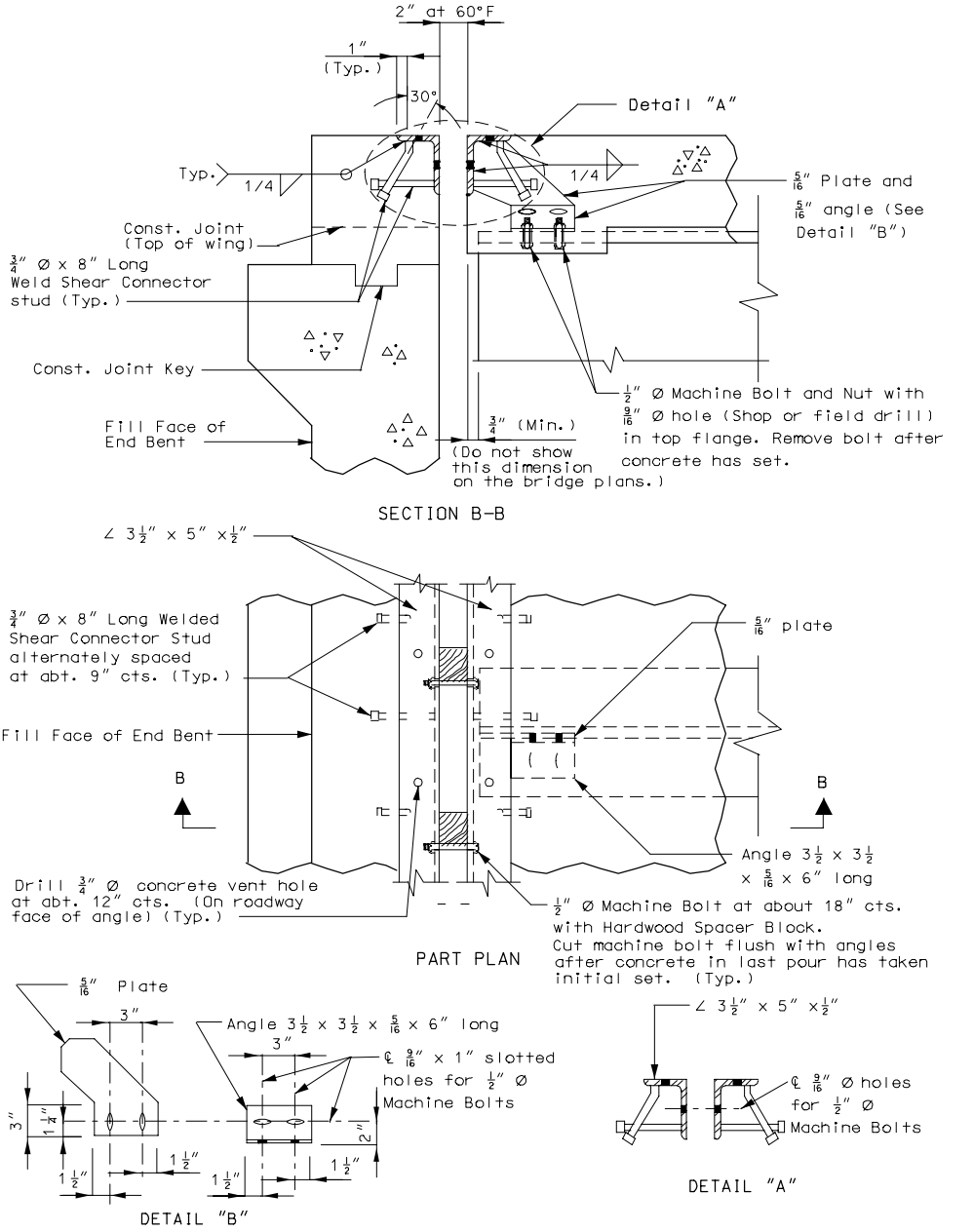
TRANSVERSE BRIDGE SEALANT DIMENSIONS



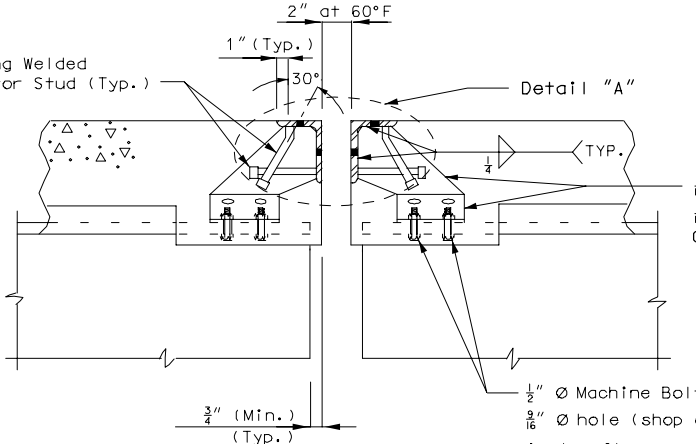
PART CROSS SECTION THRU EXPANSION JOINT

Minimum thickness of angle shall be $\frac{1}{2}$".

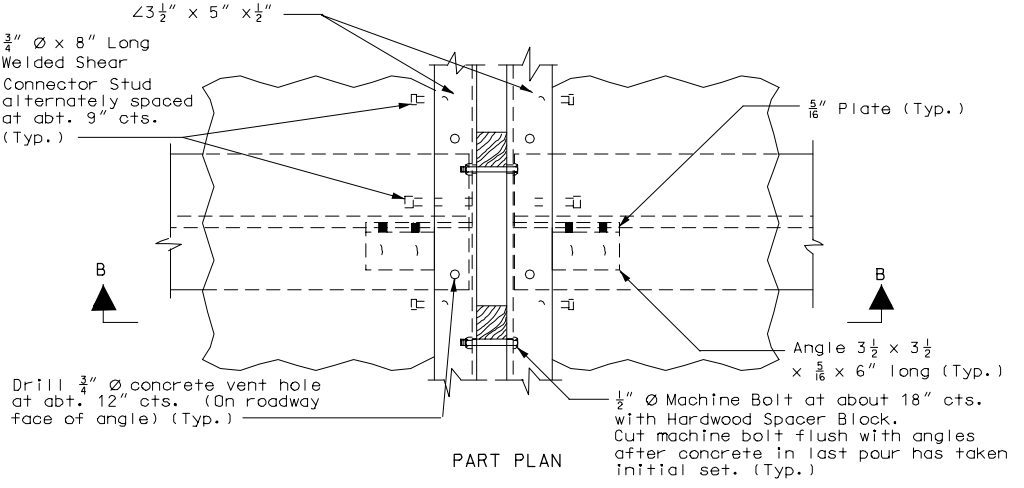
Note: See Bridge Manual Section 4.0 for appropriate notes.


2″ at 60°F
1″ (Typ.)
30°
Detail "A"
Typ. 1/4
1/4
5/16″ Plate and 5/16″ angle (See Detail "B")
Const. Joint (Top of wing)
3/4″ Ø x 8″ Long Weld Shear Connector stud (Typ.)
Const. Joint Key
Fill Face of End Bent
3/4″ (Min.) (Do not show this dimension on the bridge plans.)
1/2″ Ø Machine Bolt and Nut with 9/16″ Ø hole (Shop or field drill) in top flange. Remove bolt after concrete has set.
SECTION B-B
∠ 3 1/2″ x 5″ x 1/2″
3/4″ Ø x 8″ Long Welded Shear Connector Stud alternately spaced at abt. 9″ cts. (Typ.)
5/16″ plate
Fill Face of End Bent
B
B
Angle 3 1/2 x 3 1/2 x 5/16 x 6″ long
Drill 3/4″ Ø concrete vent hole at abt. 12″ cts. (On roadway face of angle) (Typ.)
1/2″ Ø Machine Bolt at about 18″ cts. with Hardwood Spacer Block. Cut machine bolt flush with angles after concrete in last pour has taken initial set. (Typ.)
PART PLAN
5/16″ Plate
3″
Angle 3 1/2 x 3 1/2 x 5/16 x 6″ long
3″
℄ 9/16″ x 1″ slotted holes for 1/2″ Ø Machine Bolts
3″
1 1/2″
1 1/2″
1 1/2″
1 1/2″
2″
DETAIL "B"
∠ 3 1/2″ x 5″ x 1/2″
℄ 9/16″ Ø holes for 1/2″ Ø Machine Bolts
DETAIL "A"

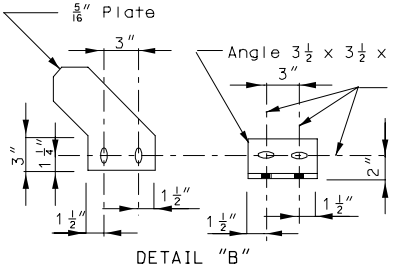
DETAILS AT INTERMEDIATE BENTS (STEEL STRUCTURES) **Silicone Expansion Joint Sealant**



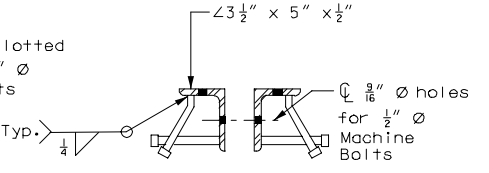
SECTION B-B



PART PLAN

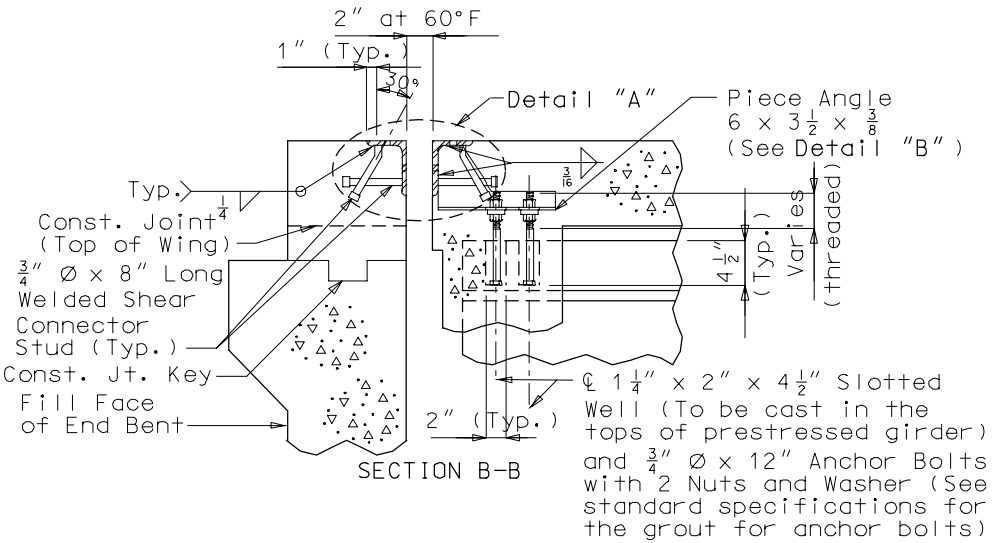


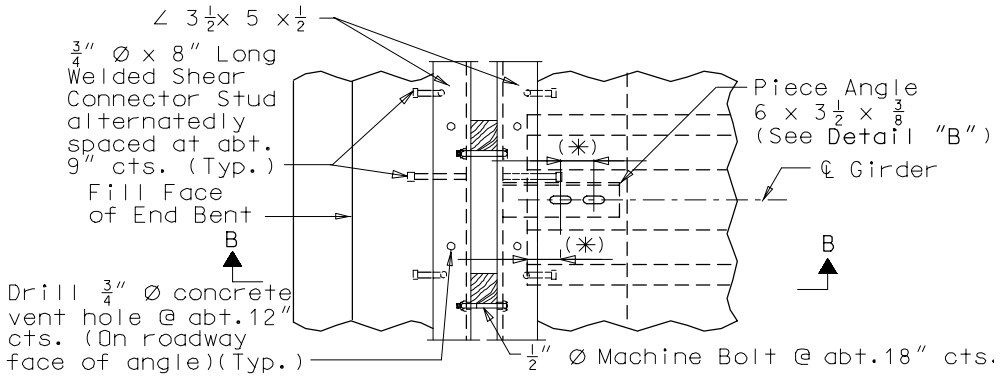
DETAIL "B"

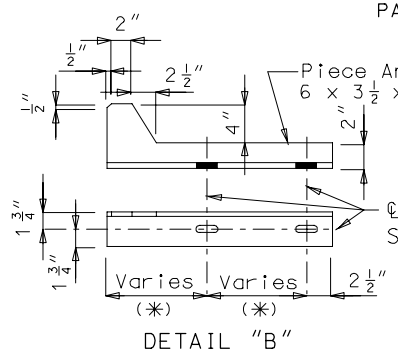


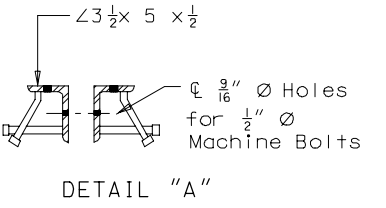
DETAIL "A"

DETAILS AT END BENTS (PRESTRESSED STRUCTURES) Silicone Expansion Joint Sealant

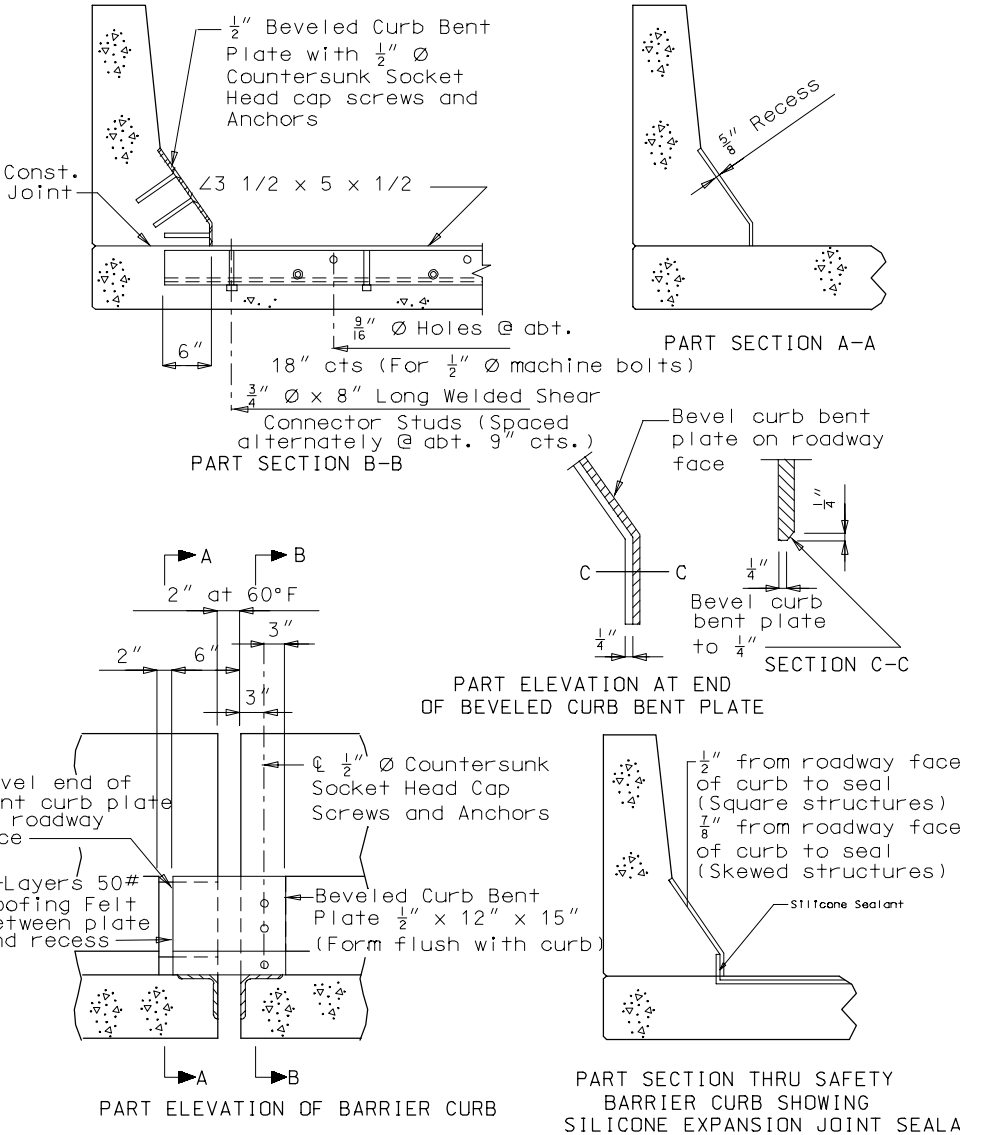




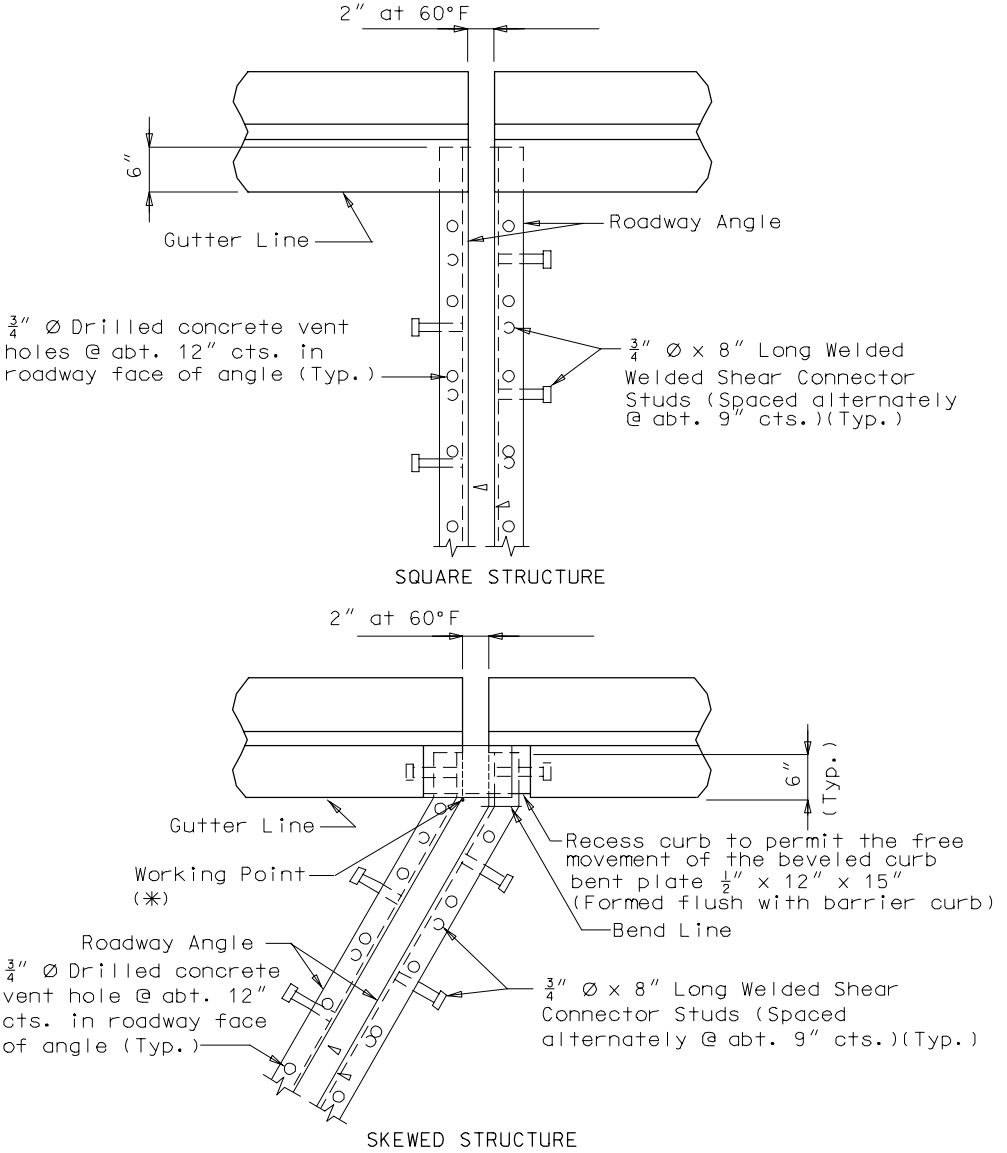




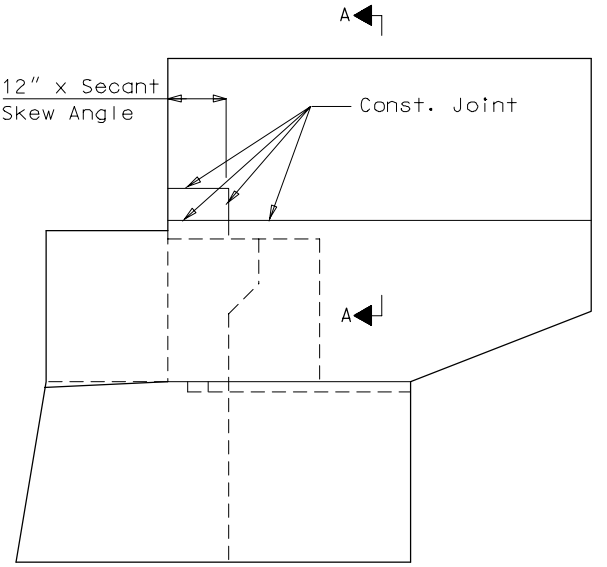
BARRIER CURB DETAILS Silicone Expansion Joint Sealant



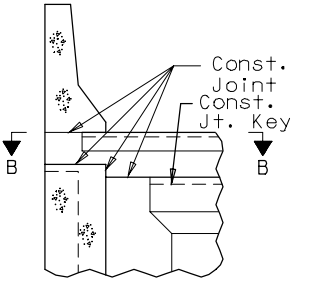
TYPICAL PART PLANS Silicone Expansion Joint Sealant



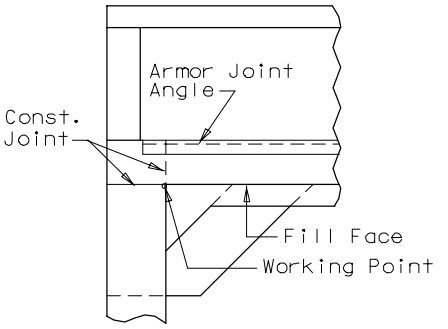
(*) The working point is always placed on the front face side of backwall at the gutter line.



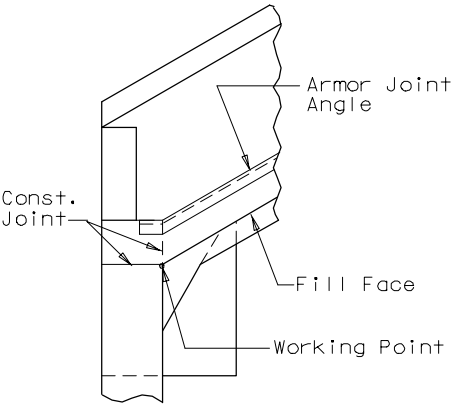
ELEVATION



PART SECTION A-A



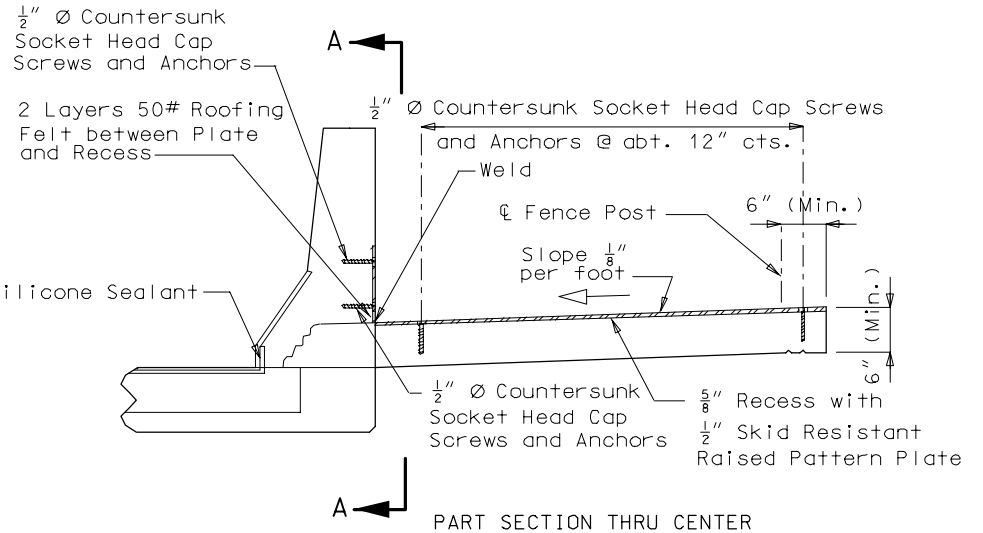
PART PLAN B-B
(SQUARE)



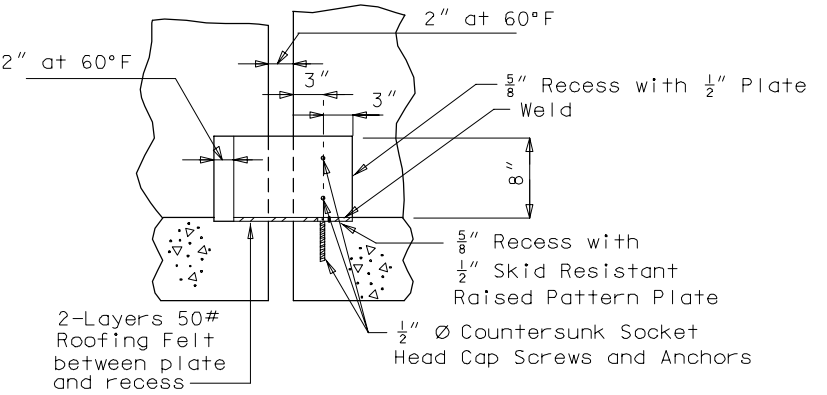
PART PLAN B-B
(SKEWED)

SIDEWALK DETAILS Silicone Expansion Joint Sealant

See bridge manual Section 3.30 (General Superstructure) for details and reinforcement of the sidewalk and bridge manual Section 4 (General Notes) for the appropriate notes to use on the bridge plans



PART SECTION THRU CENTER OF EXPANSION DEVICE

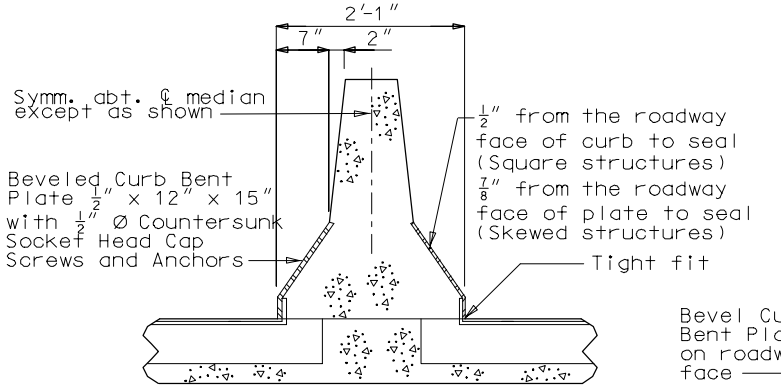


PART SECTION A-A

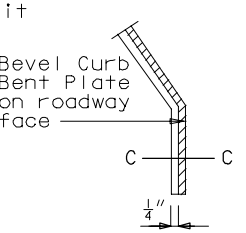
DOUBLE FACED MEDIAN BARRIER BRIDGE CURB Silicone Expansion Joint Sealant

Note:

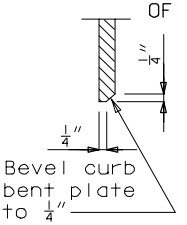
For details not shown of median barrier bridge curb, see the safety barrier curb details (General Superstructure Section of Bridge Manual), Design Division Standard Drawings (Concrete Median Barrier) and Bridge Design Layout.



TYPICAL PART SECTION A-A

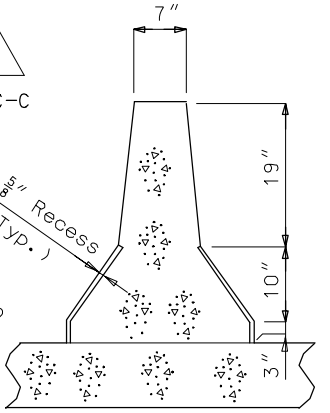


PART ELEVATION AT END OF BEVELED CURB BENT PLATE



SECTION C-C

PART ELEVATION OF BARRIER CURB

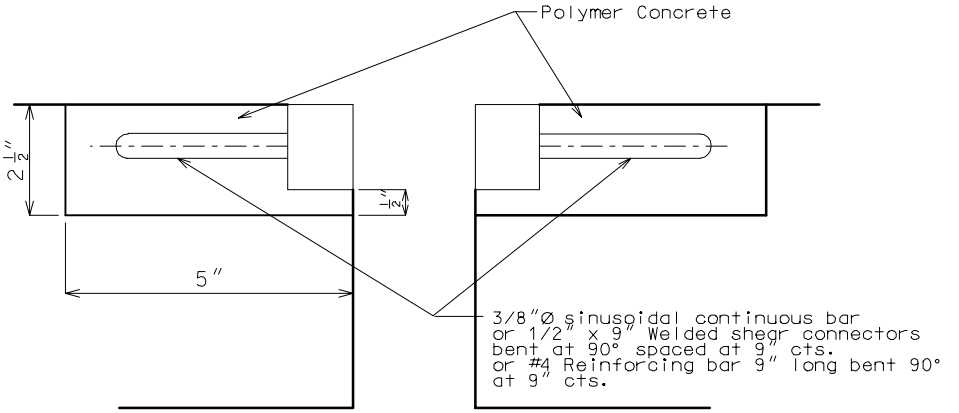


TYPICAL PART SECTION B-B

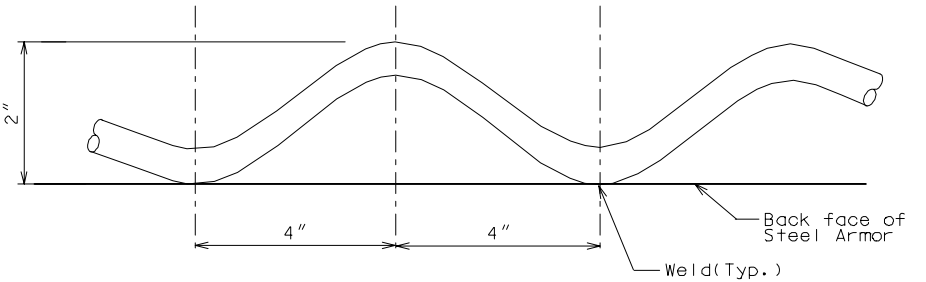
POLYMER CONCRETE

Silicone Expansion Joint Sealant

Silicone Expansion Joint Sealant may be used on rehabilitation projects where other expansion devices need to be replaced. Consult with Structural Project Manager about the use of polymer concrete with silicone sealant. Silicone sealant is to be designed with the same requirements as a normal silicone expansion joint sealant.

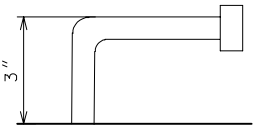


Note: Anchorage system shall be welded to ssteel armor with appropriate weld to meet AASHTO Fatigue Category C for connection.



DETAIL OF SINUSOIDAL BAR

Note: A pay item exists for this type of expansion device system. The system will be paid for under Silicone Expansion Joint Sealant System, per linear foot. Polymer concrete will be paid for under Polymer Concrete per cubic foot.



DETAIL OF SHEAR CONNECTOR

(#4 Reinforcing bar shall be bent in a similar manner)